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THE MODEL ENGINEER

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25TH JANUARY 1951 VOL. 104 NO. 2592

SMOKE RINGS

Our Cover Picture

● THIS WEEK'S photograph shows the Burrell five-ton tractor No. 4048, owned by Mr. Frank Holl, of Worcester. Taken by Mr. W. J. Hughes, it shows the tractor at Hartlebury before setting out to take part in a carnival parade at Stourport, along with a Fowler and another Burrell. A description of the event is given in this issue.

Parker's Small Steamboats

● WITH FURTHER reference to the old model steamboats mentioned in our "Smoke Rings" for January 4th, Mr. H. Holcroft, M.I.Loco.E., has supplied us with some very interesting notes which we intend to follow up, as the principle of propulsion would seem to have embodied one of the earliest practical applications of the jet—so familiar to us now.

The patent was No. 2620 of 1863 for a new form of motive power intended mainly for the propulsion of road locomotives. The invention required eight years to develop to a practical success, after much toil and perseverance involving thousands of experiments. A description appeared in *The English Mechanic* in July, 1865, and an illustration in the same publication in March, 1867.

However, such a form of motive power was defeated by the conditions at the time; the rough state of the road surfaces, iron-shod wheels and the necessity for a man with a red flag to precede the vehicle discouraged the inventor, so he turned his energies to water transport and propelled launches on the Grand Surrey Canal by means of air-steam jet propulsion. Models on the same principle were on sale, and were obtainable up to 1890, or thereabouts.

Mr. Holcroft states that in *Engineering*, Vol. 3, page 61, January 18th, 1867, there appeared an announcement of Jas. Parker's steam-and-air engine. In this device, heated air was injected or drawn into the steampipe by specially-designed nozzles and receiving-cones; consequently, the mixture reached the engine at reduced pressure, about one-third of the boiler pressure. The test reports did not include data on fuel consumption; so no really convincing results were presented. Furthermore, it is difficult to conceive any increase in efficiency or economy by using such a method.

In 1870-1, *The Engineer* published several references to this system, and nineteen years later, the same paper reported a series of tests extending over two days. During the first day, tests were made with steam as the medium; on the second day they were made with the air-steam mixture. But fuel consumption, it seems was about the same for all tests.

Mr. Parker appears to have been nothing if not persistent! He did not achieve his main object, but his little steamboats and a number of different types of small, toy engines met with some considerable success. As a boy, Mr. Holcroft possessed some of them; hence his interest in this matter.

The "Silver Ghost"

● AS A sequel to the article on the Rolls-Royce "Silver Ghost" by C.L.M. which we published in October, 1950, we have received a letter from Mr. N. W. Bertenshaw, Keeper of the Department of Science and Industry, City of Birmingham Museum and Art Gallery, informing us that his department, which is in the process of development, has procured the loan of the model from Messrs. Rolls-Royce Limited for a short period.

The museum is to be housed in the premises which have been occupied for over a century by the famous firm of Elkington's, where most of the Elkington Plate was made. It will be some time before the premises can be adapted as a museum, devoted to the explanation of fundamental scientific principles, and to exhibits concerned with industrial development and manufacturing processes, "but," says Mr. Bertenshaw, "there have been several cases during this early development work where we have found your excellent magazine of value."

Astonishing Mileage

● ON THE 20th December last, British Railways Western Region 2-cylinder 4-6-0 locomotive No. 2908 *Lady of Quality* was withdrawn from service. This, in itself, may not have any more significance than the withdrawal of any other old locomotive; it will cause at least a momentary pang of regret to those readers who can remember the *Ladies* when they were built in 1906 and who have watched with admiration the work which those locomotives have done so consistently well since then.

The interesting point about *Lady of Quality* is that, in the course of 44½ years, she had put up a total mileage of just on 1,850,000; in addition, she had the reputation of being the strongest "29" the Western ever had. In her earlier years, she was well known at Paddington, Plymouth and Birmingham on top-link express passenger trains; later she was stationed at Bristol, from which place she ran trains to most other places on her own road. For the last two years, she has been working from Swindon, her birthplace, and was frequently to be seen on fast passenger trains to Paddington even during last summer. Our last sight of her was on Saturday, December 2nd, when she worked a fast main line freight train from Acton, probably taking it as far as Swindon on its way to Bristol and the west.

Truly, she had earned her keep and thoroughly well lived up to her name. Her withdrawal leaves only one of her immediate contemporaries, No. 2906 *Lady of Lynn*, still in service and stationed at Tyseley.

N.B.—1,850,000 miles is equivalent to 70 trips round the world!

"More Haste—Less Speed!"

● ONE OF our correspondents has commented on the tendency of many model engineers, in the desire to produce a model as quickly as possible, often to defeat their own object by using hurried and inefficient set-ups for machining operations. He points out that many operations are carried out with a very rough and precarious rig, reminiscent more of the artistic work of the late Mr. Heath Robinson rather than of correct workshop practice. The result is that accuracy often suffers, and considerably more time is involved in botching up the imperfect result to work, more or less satisfactorily, than would be entailed in making a special tool or fixture. We can endorse our correspondent's opinions from our own experience, and as a result of many bitter lessons which we ourselves have encountered, we advise readers never to grudge time taken in setting-up or making special tools and appliances. These need not, however, be of an elaborate nature so long as their basic purpose is properly served. In many cases where a special appliance has been made to do one particular job, it will be found to be capable of adaptation to many other purposes later on, possibly with some slight modification of detail. The desire to see one's model finished and working as soon as possible is a very natural one, but the impetuous model engineer will find a world of wisdom in the Italian proverb *festina lente*—make haste slowly!

A Lecture Course on Liquid Fuels

● WE ARE informed by the Department of Applied Chemistry at the Northampton Polytechnic, St. John Street, E.C.1, that they are organising a course of lectures on liquid fuels, their properties and utilisation, which will be delivered by Mr. G. F. J. Murray, B.Sc., on Tuesday evenings at 7 p.m., from February 6th to March 13th, inclusive. The fee for the course is 20s. payable in advance on enrolment, and applications or any enquiries on the subject should be made at the above address.

Words, Music and Photographs

● ONE OF our New Zealand readers, Mr. H. E. Clow, again sent us cordial seasonal greetings at the beginning of the year. He tells us that, during 1950, not a single copy of THE MODEL ENGINEER sent out to him went astray, and he wishes to thank all contributors for all the splendid articles we have published during the year. He sends special thanks "to the 'king of loco builders, "L.B.S.C.," whose articles I read back to front."

If we read that last sentence literally, Mr. Clow must get some curious results! Joking apart, however, we see what he means, and we hope that when he can settle down in a new home which, he tells us, is now being built, he will be able to resume construction of small locomotives according to the familiar "words and music."

Mr. Clow used to be a member of the Southport Society of Model Engineers before he went out to New Zealand, and he says that his former fellow-members send him photographs of their models, with the result that he has quite a nice album together. In this way, his New Zealand friends can see something of what is done by model engineers in the "Old Country"; he wonders if any other readers here would care to send him some photographs of their work. His address is: P.O. Box 45, Clive, Hawkes Bay, New Zealand, and we think that any spare prints with brief particulars would find a good home and do our hobby quite a lot of good in that far country.

Traction Engines at Stourport

by W. J. Hughes

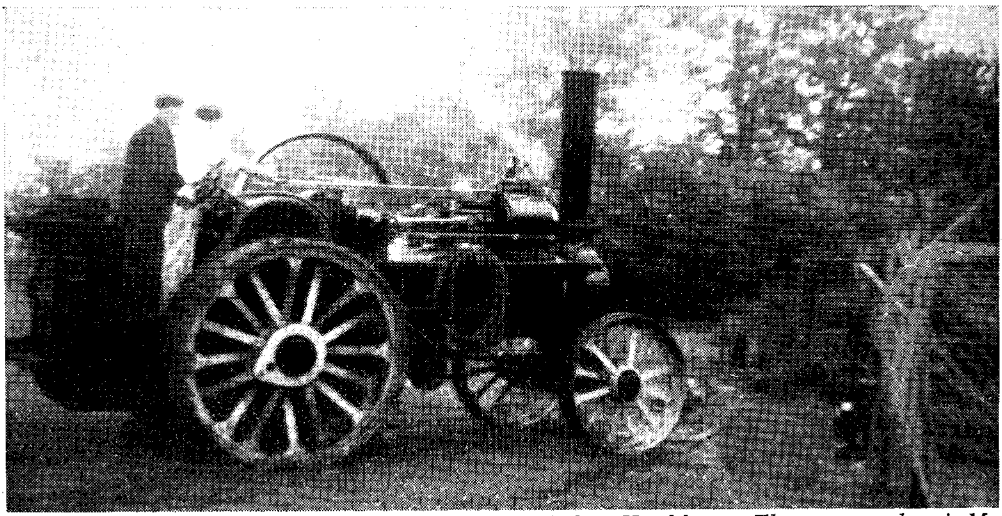
DURING an autumn month of last year, the town of Stourport-on-Severn in Worcestershire was treated to the unusual present-day sight of three traction-engines in steam. The occasion was the town's Land and Water Carnival, and the three engines were taking part in the long parade.

They were a Fowler single-cylinder general-purpose traction-engine, No. 11246, built in 1906; a Burrell single-crank compound general purpose engine, No. 2147, built in 1898, and a Burrell double-crank compound 5-ton tractor, No. 4084, built in 1928. The Fowler, of 6 n.h.p., belongs to Mr. F. W. Middleton, the Burrell S.C.C. to Mr. W. G. Carey-Walker, and the Burrell tractor to Mr. Frank Holl.

Soon after my arrival, we strolled out into the drive to inspect the Burrell 5-tonner (which had been driven over from Worcester that afternoon). There was still enough steam in her to turn her over, and we spent some time in this pleasant pastime, the while sniffing in that indescribable odour of live steam and hot oil, which only a steam vehicle possesses.

Afterwards, indoors, we were joined by Mr. John Spence, who had bought the Burrell S.C.C. and the Fowler some months ago, but since presented them to their present owners. A conversation ensued which did *not* cover a wide range of subjects! Part of the proceedings was devoted to inspecting Mr. Middleton's workshop, where a "Princess Royal" chassis and boiler shell stood on a bench. Further on was a nearly completed compound undertype engine, which ran very well on compressed air. This was to the "M.E." design of 1904, and a fine job.

But the masterpiece was the box of parts which Mr. Middleton has made for a $1\frac{1}{2}$-in. scale model of his full-sized Fowler. This promises to be the most detailed model I have ever seen, complete to the tiniest rivet and split pin, and the workmanship is in the top class, too.



Mr. F. P. Middleton driving his Fowler out of the paddock at Hartlebury. The steersman here is Mr. Frank Holl, owner of the Burrell tractor

After breakfast the next morning, the first procedure was to light the fire of the Fowler, which was done with cotton-waste soaked in paraffin, followed by firewood and steam coal. I cannot claim to have been of great service here, being too busy taking photographs and examining details of, the three engines. The Fowler and Burrell S.C.C. stood in a paddock at the side of the house, and while waiting for the others it was decided to light up the Burrell, too, so as to save time. It was not long before two plumes of smoke were curling lazily towards the overcast sky, a very satisfactory sight (the smoke, not the sky!)

Now came intense activity with cotton-waste and elbow grease, polishing the gleaming steel rods and glossy boiler-cleading until they would shine no more. Meantime, the other enthusiasts had arrived, and very soon the chimney of the Burrell tractor too was contributing to the proceedings. Oil-cups and syphons were filled all round, water-tanks filled to the brim, and coal piled into the bunkers.

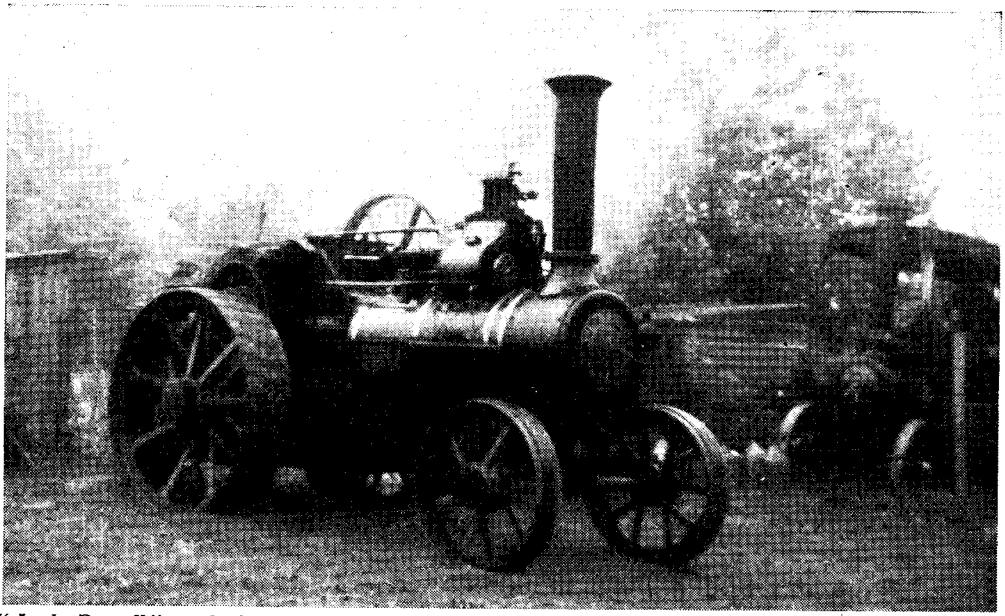
With all this activity, time passed quickly, and it seemed very soon that the Fowler drain-cocks were opened and the regulator eased forward

to clear the cylinder of condensate. With the flywheel turning slowly and the gentle throb of the exhaust in the chimney, she seemed even more alive than she had done previously with her water simmering and swelling in the boiler.

By the time the Burrell was turning over, the Fowler's safety-valve was blowing, in spite of a low fire. The needle of the tractor also was creeping over the surface of the gauge, and before long her quiet exhaust was added to the combined music.

single crank had to take the pressure of two cylinders instead of one!

Reverting to "our" S.C.C. (whose name is *Lady Burrell*, by the way), she is sprung on the hind axle, and is a three-shaft engine. The differential is on the second shaft, on each end of which a pinion drives each hind wheel separately. The front axle is of tubular construction, which looks rather unusual on a traction-engine, and which, I believe, Burrell's soon abandoned. It is not sprung.



"Lady Burrell" ready for parade. Behind her "Little Mary" blows off so enthusiastically as totally to conceal herself!

Now came a brief pause for lunch, and we were ready to go. But first let me insert a few notes about the engines themselves, in the order of age.

The single-crank compound, of 7 nominal horse-power, is over half-a-century old, and was built to the well-known Burrell design in which the high-pressure cylinder is mounted parallel with, but diagonally above, the low-pressure one. Both piston-rods drive a common cross-head, from which a single connecting-rod drives a single crank—hence the name. The slide valves work in valve-chests placed vertically one over the other on the near side of the cylinder-block; here again the valve-rods have a common cross-head, which is driven by a single set of Stephenson valve-gear.

Several advantages were claimed for this arrangement, not the least being that there were fewer working parts. In addition, in a *double*-crank engine, it was difficult to find room for two cranks and four eccentrics in the limited space between the hornplates, and Burrell claimed that the single-crank system enabled correspondingly stronger parts to be fitted—perhaps conveniently ignoring the fact that those same parts had to transmit a greater power, e.g., the

The Fowler, *Little Mary*, is of 6 n.h.p., and was built in 1906. She is of normal single-cylinder design, with Stephenson valve-gear, and has four shafts. A two-speed pinion is mounted on the crankshaft between hornplates, with a two-speed spurwheel sliding on the second shaft for gear-changing. The remainder of the gearing is all on the right-hand side, with compensating gear (differential) on the hind axle.

The five-ton tractor, *Lord Burrell*, is a mere 22 years old, and is a double-crank compound of orthodox design, with Stephenson valve-gear. Being built for road-haulage rather than general-purpose work, both axles are sprung, and she has a belly-tank for extended water capacity. Like most Burrells, and almost all tractors of whatever make, she is a three-shaft engine with the change-speed gear outside the hornplate on the right—in this case a three-speed gear.

The Journey

Owing to a long rainy period, the paddock was in a very soft condition, and there was a certain amount of trouble in getting the Fowler out from her corner. But with a gentle hand at the regulator, and a spud on each hind wheel,

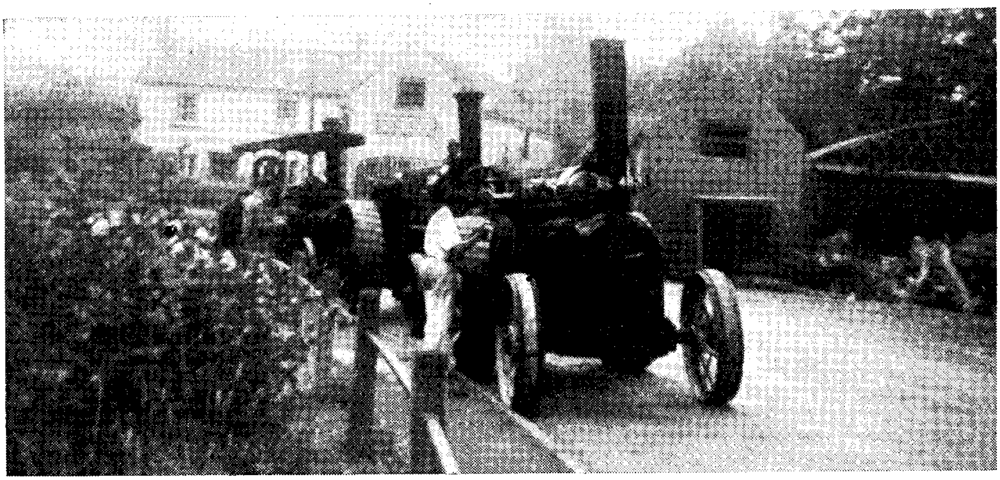
it was not long before she was safely on the hard gravel drive, where the tractor already stood.

The single-crank engine was not so fortunate, and her spinning hind wheels were quickly dug in until her tank almost rested on the turf. A spud was fixed to each wheel and another attempt was made to lift her out. The procedure was that the regulator was opened gently, and one wheel revolved until the spud bit into the ground, so stopping it. Under the action of the compensating gear the other wheel now revolved until its own spud bit. Then a quick surge of power, with both spuds gripping, and *Lady Burrell* heaved herself up and over, progressing about a yard, until the spuds no longer gripped. The whole procedure was now repeated—one wheel revolving until the spud bit, the other doing ditto, a yard's movement, and so on.

As may be imagined, this was a slow method of progress which was *not* improving the turf, and obviously something had to be done about it. To have fixed all the spuds all round would have taken quite a time, and that commodity was running short if we were to reach Stourport before the parade started. But Mr. Holl backed up the five-tonner on the drive, and the winding-rope was paid out and fastened to the front lug of her erring bigger and elder sister. The tractor's brakes were hard on, and her driving-pins out, so that the engine could rotate the winding-drum without turning the wheels. Then came a demonstration of the mighty and unrelenting power of steam, for *Lady Burrell* was placed with her wheelbase at right-angles to that of the little engine. Yet as Mr. Holl opened his regulator, the front end of the S.C.C. was slewed bodily round, and then, with steam on both engines, she came out as easily as if on a good hard road.

A short pause to secure the rope, to remove the spuds, and to have a final check that everything was right, and we were off, not too close together so as to allow room for passing traffic to pull in between on the not too wide country roads. All along the way our passage created interest and excitement, with cottagers and villagers coming to windows or garden-gates, with street corner gossipers temporarily suspending conversation, with dogs barking furiously at these belching noisy monsters, with the inevitable schoolboys on cycles courting destruction beneath steel-straked wheels. And how good it was to be on a vehicle that even the worst of road-hogs respected!

A stop was made on the way for the two larger engines to top up their tanks at a roadside pond, though the tractor did not need to fill up. It was but the work of a minute to unroll the hoses and to couple them to the waterlifters. Then a whiff of steam through the latter, and water was rapidly gushing into the tanks until they overflowed. The reason for this precaution was that it was not known how long it would be before we were able to fill up again, and it would be undesirable, to put it mildly, to run out of water in the middle of the parade.



One for the road! Mr. Middleton re-strapping the hose after "Lady Burrell" and "Little Mary" have refreshed themselves. "Lord Burrell" was not thirsty, but stayed to keep the ladies company

The remainder of the afternoon needs little telling, but I think it can be stated quite fairly that these three engines caused as much interest and comment as any other feature of the long procession. Many were the nods and waves from total strangers; and the younger generation was vastly intrigued by this sight which many of them would never have seen before, and may never again. For in these days, the sight of a *single* traction-engine in steam is rare enough—but three at once! No wonder an onlooker said to me: "I thought I was seeing things!"

However, if these and other stalwarts of the Road Locomotive Society have their way, it will be a very long time indeed before the sound of a steam exhaust is last heard on British roads. That would be a sad day indeed, as I think that most "M.E." readers will agree. So good luck attend the fortunate few who save the old-timers from the scrapyard, and may they have a good head of steam always!

*An Experimental Steam Turbine Plant

A chronicle of many endeavours and trials in the quest for high r.p.m.

by D. H. Chaddock

ANOTHER addition, of major importance in the light of subsequent events, was a hydrostatic valve to relieve the pressure in the blowlamp container in the event of feed pump failure or engine stoppage. This device was fully described by Mr. H. J. Turpin in his most instructive "History of *Tich Too*," "M.E.," February 15th, 1940. I can fully endorse his remarks about its reliability and value as a "boiler saver" particularly with the rather lively Groves boiler and I should like to pay tribute to the help and inspiration I have had from his writings.

Here it would be nice to record that when first launched at the Grand Regatta in 1949 the new turbine-engined boat streaked round the course and broke all world records. It did not. It stripped all the teeth off its pinion before it was even hooked on to the line!

It is only fair to record that it had had several "bath tub" trials previously, and, with both nozzles in operation, shown that it could at least drive a 2 in. diameter by 4 in. pitch propeller and its own pumps with a fair amount of liveliness.

"Duplex," The Answer to a Prayer

I resolved to have nothing further to do with clock gears; the epicycloidal teeth were too weak at the roots where all mine had broken. Involute teeth were the thing and furthermore, I would cut my own so as not to be dependent on the junk stalls and a very uncertain quality of material.

As if in answer to my requirements "Duplex" had just completed in 1949 a long series of articles on "Gear Cutting in the Lathe" and shown how the necessary cutters could be made and backed-off. Now, much as I admire our friends' work and methods it did seem to me that the eccentric turning fixture, although highly ingenious caused rather a lot of work, to make one cutter,

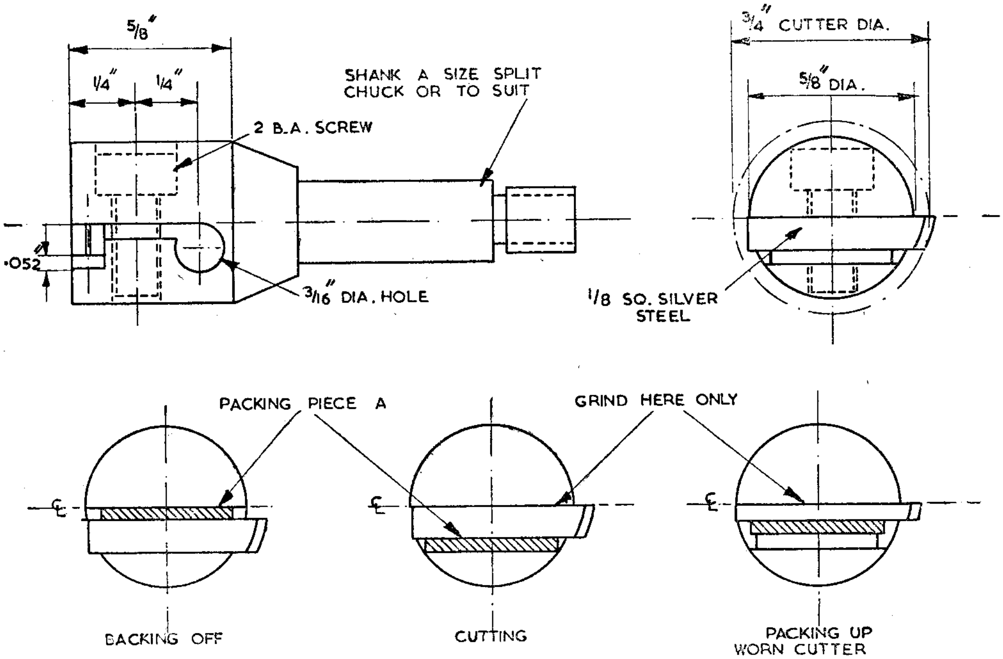


Fig. 19. A single-point flycutter spindle for both backing off cutters and form-milling gear teeth

**Continued from page 114, "M.E.," January 18, 1951.*

to produce one gear. Furthermore, I do not like multi-tooth cutters for accurate work unless they can be ground after hardening and the single-tooth flycutter variation appealed to me much more. But it still required the eccentric turning gadget to form it and a rather complicated honing jig to sharpen it afterwards.

One Job, One Tool

An essential feature of the " Duplex " backing-off method is that the centre line is displaced by a certain amount relative to the cutter during the process. The same result is achieved if the centre line remains in its normal place and the cutter is displaced.

Fig. 19 shows a flycutter holder which can first be used to form and back-off the cutters and then, after they have been hardened and sharpened, holds them in the correct relative position for cutting. No eccentric turning fixture is needed and no special tackle is required for resharpening.

The crux of the matter lies in the use of the little distance piece *A*. It can be made of gauge plate, accurately worked to thickness and hardened and tempered. It is always used. Placed above the cutter blank it displaces the cutting edge by the amount of its thickness, in this instance 0.052 in., and by ordinary turning causes the cutting edges to be backed-off relative to the working face of the cutter. Replaced below the cutter the working face of the latter is restored to its normal or centre line position.

If the cutters are originally made from square silver-steel, which is checked for its accuracy, they can be reground on their top faces *ad lib.* by offhand methods on stone or wheel, it only being necessary to check by micrometer after the grinding that the top and untouched bottom face still remain flat and parallel. After much regrinding a further piece of packing may be put under the cutter to make up for its loss of thickness and to save straining the body in clamping it firmly. Such a piece of packing is evident in the photograph, Fig. 20. At all times the working face of the cutter remains accurately on the centre line and the off-set split in the body ensures that the holding rather than the locating face springs on tightening up.

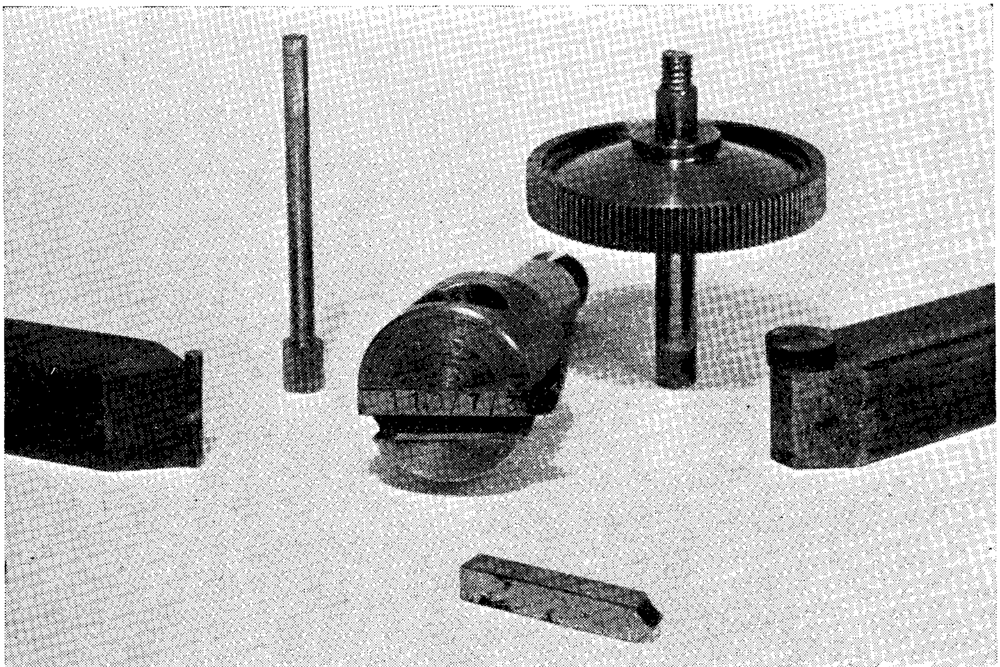


Fig. 20. The flycutter and its work. These gears have run at over 80,000 r.p.m. Right and left : single and form tools

Form Tools

" Duplex " employed a twin circular cutter form tool which shaped both sides of the blank simultaneously. They (for there are two) rightly emphasised that the spacing of the two circular cutters was critical and recommended that the lathe leadscrew be used to obtain accuracy.

I used a single circular form tool to do all the turning and forming operations spacing it directly by reference to the lathe leadscrew and cross-slide screw, both of which have indexes.

The *modus operandi* is shown in Fig. 21 and will be apparent to anyone used to using the lathe indexes to size work. The only important difference is that the amount of infeed is *not* that given by " Duplex " in the tables since we are now working from the tip of the cutter

and not a corner on a blank of prepared thickness, a much more accurate procedure. The revised infeed can be readily worked out, however, as the geometry is only one of circles and can be solved by remembering to what the square on the hypotenuse is equal.

Home-made Gear Delivers the Goods

The photograph shows not only the flycutter used for cutting the pinion, but in front of it the cutter for the wheel, and to left and right, respectively, the form tools for shaping them. Both have plain mild-steel shanks, $\frac{3}{8}$ in. square, that on the right carrying a hardened steel disc 0.25 in. diameter on a spigot and pressed in. That on the left is only 0.0636 in. diameter. Fortunately, a piece of silver-steel was found of this size, brazed to the end of the bar and quenched out in the same heat.

Behind them are the pinion, integral with its shaft, and the wheel. Both are 110 d.p. involute form, 30 deg. pressure angle. The pinion has 15 teeth, $\frac{3}{16}$ in. wide, and the pitch circle diameter is 10 thou. under $\frac{3}{16}$ in. diameter. It was turned from a 60 tons per sq. in. high-tensile aircraft bolt which was rather hard on the silver-steel flycutter but by keeping down the speed it was managed. The wheel has 120 teeth, 1.09 in. pitch circle diameter. It is phosphor-bronze and is, in fact, the old epicycloidal tooth wheel with the teeth turned off and recut, the change in tooth form and diametral pitch making this practicable.

To take this photograph the gears were specially dismantled after they had run in numerous tests and survived many smash-ups.

The pinion must have made over half a million revolutions at speeds up to 80,000 r.p.m. and transmitting more than a $\frac{1}{4}$ h.p. This is mentioned, out of context really, to show that amateurs need not be afraid of gears cut by simple methods, and to give credit to "Duplex" for the inspiration of their ideas, without which I should never have tackled it.

More Lake Trials

With its new gears the plant was put back in the boat and made its next public appearance at the Blackheath regatta in October, 1949. Not, I hasten to add, in competition but after the festivities were over. It was hooked on to the light line, the all-up weight is only 3 lb., but there was insufficient power to cause it to plane or even draw the line tight. It cruised in circles of ever-decreasing radius until—no, this is a respectable journal—the propeller fouled the slack line.

The pundits advised me to try a finer pitch propeller and also to shift the tethering plate so that the torque of the propeller would turn the boat away from the line.

This was done and the bath tub trials resumed. I was now puzzled by the extreme heat of the steam, the boiler never flooded and the heat of the exhaust steam was so great that the varnish of the hull in the engine compartment was blistered. Thinking some inadvertent alteration to the plant had, in some remarkable way, increased its steaming power I increased the bore of both nozzle throats, first from 0.020 in. to 0.025 in. and finally, 0.030 in. This certainly made the plant very lively, almost too much so for the bath tub and it was tried again at the lake. Running free it had just enough power to begin planing but obviously not enough to be worth putting on the line so no record of the actual speed was obtained. I came away that day convinced that much more power and speed was needed before a further pond trial was worthwhile.

Bench Tests Resumed

The first thing was to put the plant back on test, exactly as it had been running in the hull and find out how much power it did give. After one or two stoppages to clear the filters of the semi-solid substances that pass for water in South London public ponds, this was done and the plant returned 0.061 h.p. on a 6 in. torque bar with the turbine running at 49,300 r.p.m.

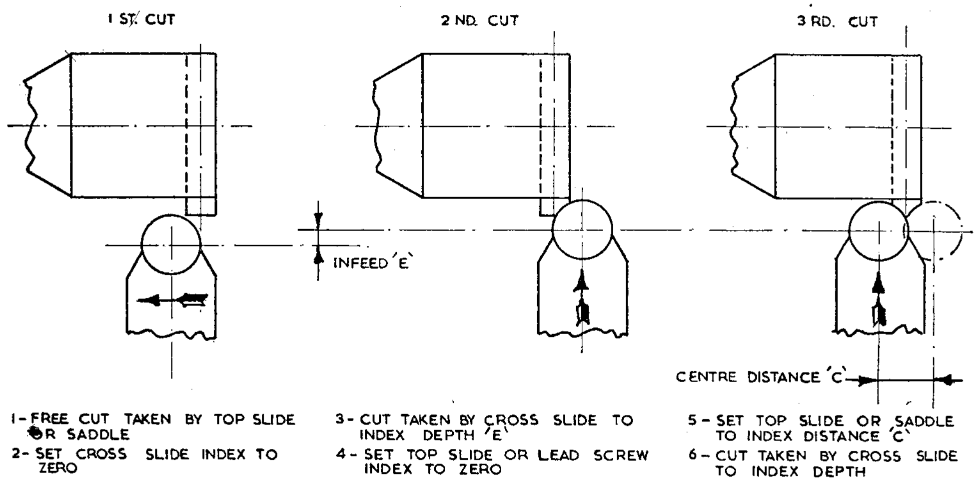


Fig. 21. The sequence of forming both flanks of a gear tooth cutter with a single circular form tool

As the plant was now driving its own pumps, in contra-distinction to the previous tests, this was net power and I was not dissatisfied.

Various parts were replaced and attempts made to tune the plant up, but on each test the performance seemed to get erratic and on one test, pump as I would and with the relief valve lifting, only a trickle of steam came from the nozzles. Everything was stripped and cleaned and the boiler blown out, but I could find no reason at all until my eye alighted on the parts that were strewn on the bench and I fell to wondering how the water got from the stem of the new hydrostatic valve into the boiler feed banjo with no drilled hole in it. No drilled hole! It never had been drilled and all the feed the boiler had been receiving was seepage up the screw threads of the stem. To drill a hole was a matter of seconds, but in the next run the enlarged nozzles allowed far too much steam to pass and the boiler flooded.

The nozzles had, of course, now been spoilt for the designed pressure and temperature because the throat area was out of proportion to the outlet area. The only thing to do was to drop the working pressure by unscrewing the relief valve and to work the boiler harder. Overzealous application of the air pump to the blowlamp in one of these runs, however, caused it to flood in full blast. The customary jet of burning petrol, however, instead of being shot against the opposite wall of the workshop was caught in the whirling fan brake and atomised into a fully aerated flame about 3 ft. in diameter and 1 ft. thick. I had never seen anything like it, but as I never put more than 1 oz. of petrol in the lamp in these indoor tests it was soon over and no damage was done beyond singed eyebrows and lashes.

However, after one or two further trials and adjustments the plant was got to run reliably although rather near the limit of its performance.

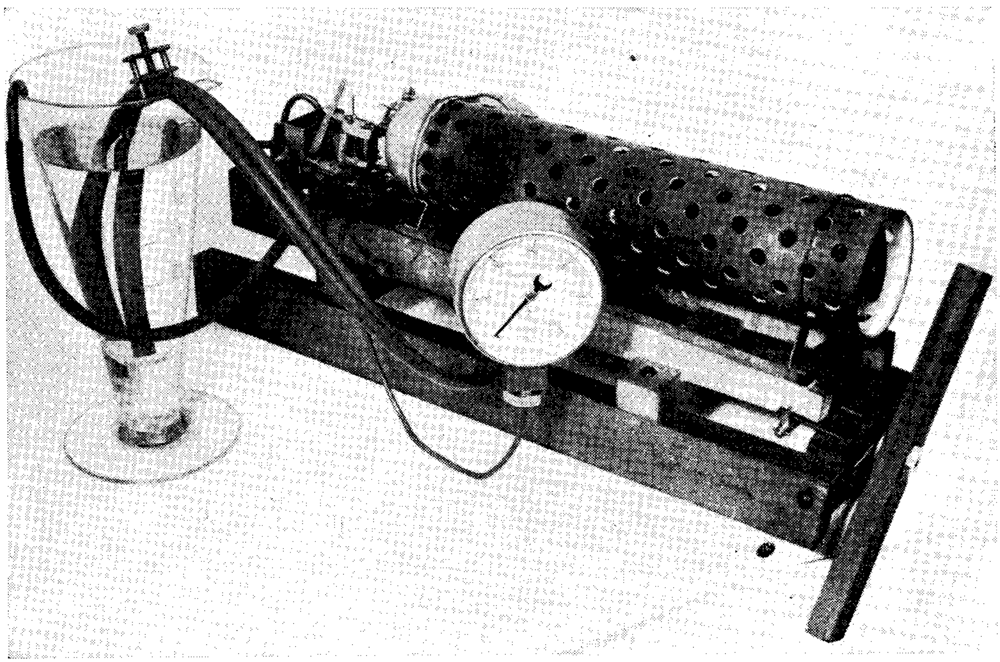


Fig. 22. The plant set up on the test bench for simultaneous measurement of speed, power, pressure and water consumption

S.M.E.E. Stationary Engine Committee Test

The complete test bench set-up in use at this time is shown in Fig. 22. The torque bar and speed indicator have already been described. The water consumption was recorded by drawing the supply from a graduated glass measure to which the overflow from the relief valve was also returned so that the net feed was taken.

To get simultaneous readings really needs three observers, two with stopwatches to time the speed and rate of water consumption and one to record the steam pressure. The plant was therefore taken up to the S.M.E.E. workshop and with the help of some fellow members of the Stationary Engine Committee a fully observed run made. A 6 in. torque bar was in use and at 290 lb. per sq. in. pressure this was driven at 8,650 r.p.m. equal to 0.165 h.p., the turbine running at 69,000 r.p.m. The water consumption was found to be 4.1 oz. per min. so that the steam rate worked out at 93.5 lb. per brake horse power per hour. An attempt at a second run ended in main bearing seizure and on stripping

one nozzle was found to be blocked so that it is doubtful if both nozzles were in action in this run.

This result was very encouraging, the horse power had been increased from barely $\frac{1}{16}$ to 1/6, nearly threefold and was beginning to come into the region that might be useful in a small hydroplane. It was marred, however, by the bearing seizure which, in fact, proved to be the first of a long series. Bearings without grooves, with left-hand and right-hand, and with both hands of grooves were tried but with indifferent success. There seemed to be one infallible rule. If the bearings fitted well they would, sooner or later, seize, not in the first run, but perhaps in the second or third. Only when they were so slack that they rattled was there a guarantee of no seizure, but there was then a grave risk that the wheel would rub the nozzles or the gears jump out of mesh or both.

Finally, in despair and on the advice of Mr. Westbury, I abandoned bronze bushes and tried carbon instead. I was too anxious to wait for proper bushes from the Morgan Crucible Co. and made the first pair from an electric motor brush, turned down and drilled out. It showed no sign of seizure and ran even better without oil than with it, but the material was so soft, that very few runs wore it beyond acceptable limits.

The next experiment was with bushes made from an arc-lamp carbon, a most unsuitable material for bearings no doubt, as it is hard and gritty, but so far it has worked without too much trouble from wear.

The plant now seemed to have settled down to a fair degree of reliability. Owing to various improvements shown in Fig. 23, rebalancing the wheel, fitting an exhaust casing round the turbine to keep the spent steam out of the blowlamp flame, and rewinding part of the boiler coils, the power had very considerably improved. It could be relied upon to give something in the region of $\frac{1}{4}$ h.p. and on one glorious occasion when everything was going just as it should it ran up to 10,800 r.p.m. with the 6 in. torque bar, equal to 0.328 h.p., the turbine doing 86,400 r.p.m.

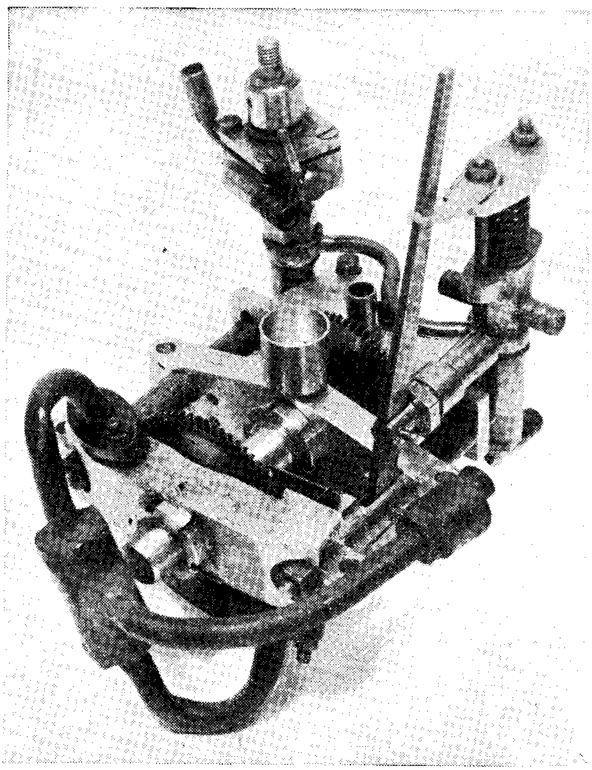


Fig. 23. The steam plant in its final form

With this I should have been content and immediately put the plant in the hull for a lake test, but I wanted to make one more improvement. A new main bearing, $\frac{7}{8}$ in. long instead of $\frac{5}{8}$ in. was made and this, of course, meant a new main shaft and pinion. Unfortunately, the gear cutting was not as good as before and careful measurement showed that the new pinion was about 3-thous. down on tooth thickness. It should have been scrapped there and then, but I was tempted to use it. A couple of runs on the test bench, and it seemed to be all right and back the plant did go, in the hull. As if in sympathy with such treatment the feed pump gears, which had so far given no trouble whatever, stripped. They were replaced, but on the next run the bronze mainwheel became tired of its malformed partner and gave up the unequal contest.

The Next Stage

I feel that the present plant has reached the end of its usefulness. It has shown that a small steam turbine can be made to give a useful amount of power on a moderate steam consumption. It has also shown that the present design has mechanical weaknesses in relation to the power being developed. In particular, better gears and bearings are urgently needed before the inherent simplicity of the high speed model steam turbine can be exploited to the full.

A new design is already in hand which it is confidently hoped will pass the six-figure mark in the matter of revolutions per minute. Also a new boiler which, with no increase in weight or heating surface but following the ideas already found to be successful, will it is hoped steam six nozzles instead of the two at present.

If this can be achieved, then I think it can fairly be claimed that the first part of the investigation has been successfully completed and that having overcome one insuperable obstacle, in the way of a model gas turbine, there is no reason why the rest should not be dealt with likewise.

"*PAMELA*" by "L.B.S.C."

A 3½-in. Gauge Rebuild of a Southern Pacific

As some of the good folk who are building *Pamela* have exhorted me not to forget to include a diagram of the pipe connections, here we are, all-present-and-correct-sergeant. I hope you'll find it a little more intelligible than some of the schematic diagrams for radio and television sets! There is one thing in which it differs from the latter, inasmuch as it doesn't matter a bean where the wires go, as long as they start and finish at the right places; but the pipes should be run by the nearest route between terminal points, whilst taking tidiness and accessibility into account. I'm rather proud of the pipe work on my own engines, especially where exposed to view, as on the footplates; but have also seen some awful examples of pipe fitting, on expensive commercial and professional jobs. I remember in one particular instance, on a 2½-in. gauge 4-6-2 which cost over three figures, that the water pipe leading from the drag beam to the suction end of the pump valve-box, had five joints in it, two of which were right-angle bends. I put the engine in good order for a friend who had been badly let down, and replaced this particular bit of Heath Robinson plumbing, by a single straight pipe.

The diagram is practically self-explanatory, and any builder who has thus far succeeded in building the engine, certainly has enough "gumption" to do a neat job of plumbing. The following tips might be useful. There is no need to put the injector delivery pipe between the frames at all; on my *Tugboat Annie*, it goes along under the running board until opposite the dome, and then turns straight upward, and follows the curve of the boiler to the top feed fitting. On *Pamela*, the top feed fittings are directly above the gap between the driving and trailing coupled wheels; so it is a simple matter to arrange for the auxiliary clack to be in that position, lying close to the frames, the connecting pipes to injector and top feed being as indicated. No support is needed for either the clack or the injector, these feather-

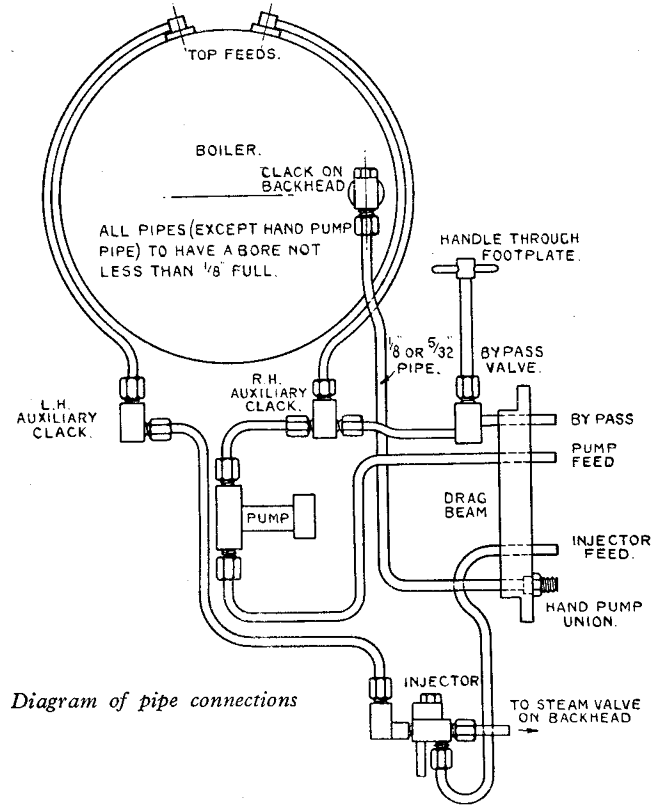
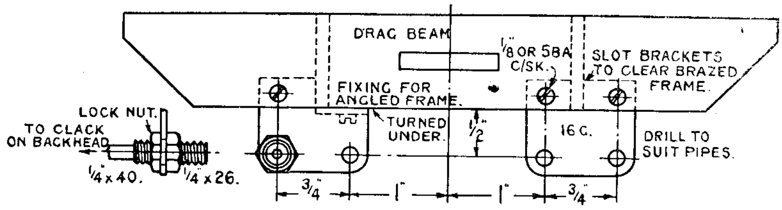


Diagram of pipe connections

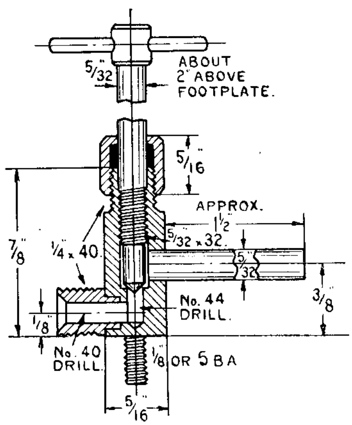
weight accessories being easily sustained by the pipes. There is plenty of room for a nice easy bend between the injector and the clack.

Pipe Brackets under Drag Beam

Another illustration shows my "standard" connections under the drag beam, for $3\frac{1}{2}$-in. gauge engines, allowing any engine to be used with any tender; the sole exception being my Webb compound *Jeanie Deans*, which (like big sister) has the reverse shaft right across the back of the engine, necessitating a special arrangement of pipe connections. As long as the pipes are in the right places, it doesn't matter how they are supported. Where the side frames are deep, and project below the beam, ordinary clips and pipe hangers may be used. In the present instance, the easiest way is to use plate brackets, as shown in the drawing. These brackets are merely pieces of 16-gauge metal, brass or steel, measuring $1\frac{1}{8}$ in. × 1 in. The bottom corners are rounded off, and holes to suit the pipes are drilled at



Pipe arrangement under drag beam



Bypass valve

$\frac{3}{4}$ in. centres as shown, $\frac{3}{16}$ in. from the bottom. The hole for the hand pump union is drilled $\frac{1}{4}$ in. clearing. To save time, I'll mention here that this gadget is made from a $\frac{3}{4}$ in. length of $\frac{3}{8}$-in. hexagon brass rod. One end is machined up exactly as described for union screws, but use $\frac{1}{4}$ in. × 26 thread; the coarser thread is easier to engage when coupling up on the road, and naturally the bigger threads have a longer life. Where a union is seldom or never disconnected, as in footplate fittings, and most of the pipe connections, a fine thread is desirable, as it allows the cone on the pipe to be pulled into perfect contact with the countersink in the fitting, without unduly straining the union nut. In the present instance, the union is disconnected every time the engine finishes a run; and for this the coarser thread is better. The other end of the union is screwed $\frac{1}{4}$ in. × 40, furnished with a locknut, and counterbored to take the pipe. The hole through the fitting should be No. 40 drill size. The pipe is silver-soldered into the counterbore, and the fine-threaded end of the fitting pushed through the bracket and locknutted, before the union nut and cone are attached to the other end. This is shown in the little detail side view.

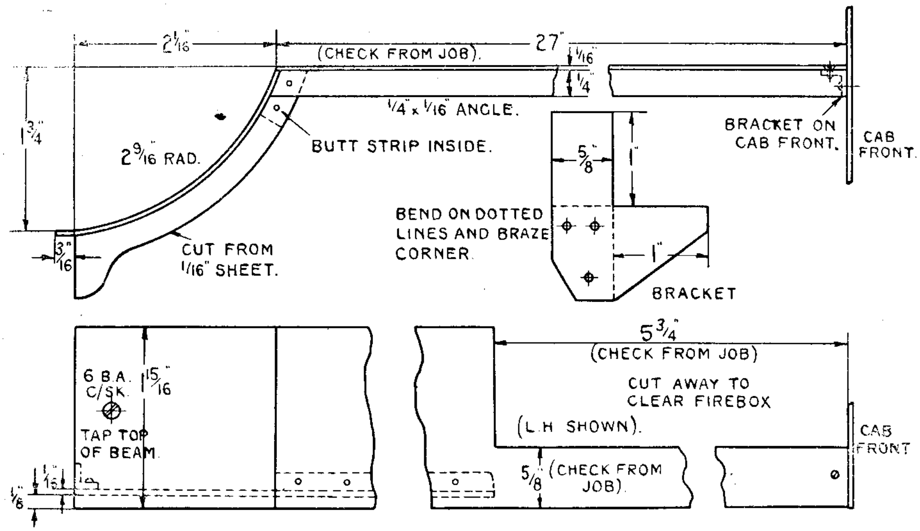
If the frames have been brazed into the slots in the drag beam, merely slot the brackets to clear the frames, and attach them by $\frac{1}{8}$ in. or 5 B.A. countersunk screws passing through clearing holes in beam and bracket, and nutted outside the bracket; see illustration. If angles have been used for attaching frames to beam, this arrangement is ruled out of court; and the alternative is to bend the piece of bracket at right-angles, so that it comes below the frame and fixing angle. A countersunk screw and nut will hold the vertical part, as shown; and the horizontal part can be held by a cheese-head screw run through a clearing hole in the bracket, into the thick part formed where the frame and the piece of angle lie together. It won't hurt if the screw comes right in the joint, although it might not please Inspector Meticulous.

Erecting Pipes

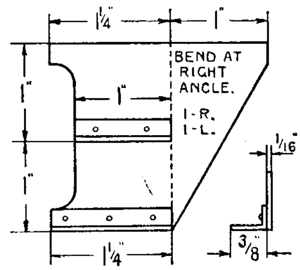
Having fixed the brackets, the length of pipe needed for each connection, is easily obtained with a wire template; my favourite is a bit of lead wire, about the same diameter as the pipe itself, but thin copper wire will do. Incidentally, the thick lead wire I use, is intended for "loading" pipes before bending them. The wire is easily pushed into the pipe, which can then be bent to any reasonable shape without the slightest risk of kinking; and if the wire won't pull out, well, you just melt it out, and that is all there is to it! As to the pipes themselves, I have stated, time and again, that if softened, by heating to red and plunging into water, they can be bent easily with finger pressure only. The union nuts are made from $\frac{5}{16}$-in. or $\frac{3}{8}$-in. hexagon brass rod, and the cones from copper, bronze or gunmetal rod, both processes having been repeatedly described in detail. For many years past, I have been making union cones out of some scrap pieces of copper rod that once did duty on the trolley wire of an electric tramway, in a Northern

provincial town, before the buses chased poor Milly Amp out of it! Milly, by the way, has been very unreliable lately; something she was never guilty of, in "company" days. She suddenly disappears and leaves me without light or power, just at the time when I am in need of it; but I hasten to add, it is no fault of hers. However, we are not completely stumped, because "Mr. Therm" deputises very well indeed in the case of my workshop bench, via a gas bracket with an inverted incandescent burner. For the living room, we have an "Aladdin" table lamp which gives nearly as much illumination as Milly's globe, as it has an incandescent mantle. I also have a powerful portable lamp of same make, which works on the Primus system, and can be used indoors or outdoors; and at the time of writing, am expecting delivery of a Tilley pressure lamp, such as is used on country railway stations, in signal-boxes, and so on, so during Milly's temporary absence, we don't suffer much inconvenience. However, when at my old home at Norbury, I ran my own power station for sixteen years; it consisted of an oil engine (which I arranged to run on paraffin and water) a $\frac{3}{4}$-kW dynamo, and a set of train-lighting accumulators. Were it not for the present awful prohibitive price of the necessary material, I should lose no time in setting up another miniature power station, thus "establishing my independence," and "cutting the cuts." Nuff sed!

As the ashpan on *Pamela* is a fixture, the feed pipe to the pump can be taken underneath it, in practically a straight line. The return pipe to the bypass valve can be brought along close to the frame, a clip being attached if there is any tendency for the pipe to sag. The by-pass valve itself is shown in section, and as it is made by exactly the same processes as fully described for the screwdown valves of the boiler fittings, repetition is unnecessary. If the outlet pipe is made approximately $1\frac{1}{2}$ in. long, it can be pushed through the hole in the bracket, so that the hose connection from the tender ("feed-bag" in the enginemen's lingo) can be slipped right on the end of it. The valve is supported by an L-shaped bracket bolted to the cradle frame; the spigot at the bottom passes through a hole in the bracket, and is nutted underneath. The pipe from the by-pass connection on the auxiliary clack on the right-hand side of the engine, is connected to the bottom union on the valve by a 5/32 in. pipe with union nuts and cones on each end. The injector feed connection is obvious, and needs no explanation.



Running-boards or side platforms

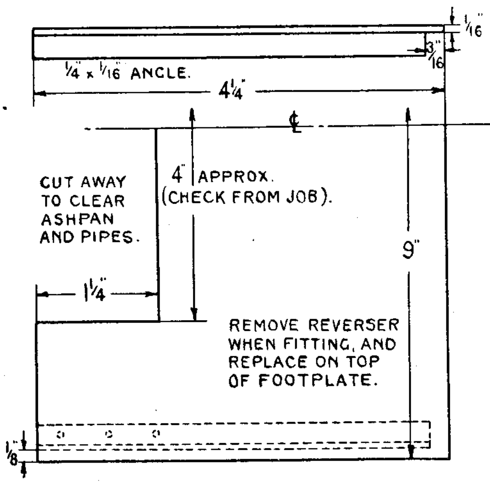


Steps

Running-boards or Side Platforms

The running-boards, or "gangways" as many enginemen call them, are made from pieces of 16- or 18-gauge blue steel 27 in. long and $1\frac{15}{16}$ in. wide. Check the exact length from the actual engine, and also mark the piece that has to be cut away to clear the firebox. The valances are $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. angle brass, riveted to the undersides of the running-boards by $\frac{1}{16}$-in. brass cr iron rivets; set them back $\frac{1}{8}$ in.

from the edge. The front part which curves down to the buffer beam, is made from a piece of similar strip, and is attached to the front end of the long one, by a piece of angle bent up from any suitable odd scrap of the self-material. The angle is obtuse, to match the joint, and $\frac{1}{16}$-in. rivets are used for fixing. Inexperienced sheetmetal workers, especially beginners, would find it a tricky job to bend $\frac{1}{4}$-in. angle to a nice curve without kinking; and to get over this difficulty, just cut the curved part of the valance from a bit of $\frac{1}{16}$-in. sheet. It can be soldered in position, with a couple of bits of angle about $\frac{1}{4}$ in. long, placed on the inside, at lower end and middle to give extra strength. At the top, a butt strip is placed at the back, bridging the joint between the curved and straight part of the valances; this can be both riveted and soldered, and if the



Footplate or cab deck

outside is scraped clean, the joint will be invisible when painted.

The complete unit is erected with the long piece level with the top of frames. The front end rests on top of the buffer beam, and can be attached to it by a single 6-B.A. countersunk screw, or two smaller ones, just as you fancy. The tops of the guide yokes and the motion bracket support part of the running-board, and a sheetmetal bracket can be added between the driving and trailing wheels. This bracket is cut out and bent, as shown in the small inserted sketch, which explains itself. The bracket is riveted to the running-board and screwed to the frame, three 3/32-in. or 7-B.A. screws providing ample strength. At the rear end, the running-board is supported on an angle riveted to the cab front, as shown in the drawing. Should there be any tendency for the running-board to lift in the vicinity of the cylinders, a bracket may be added between cylinders and guide yoke, or a small piece of "home-made" angle can be attached to the top of the guide yoke itself, and the running-board held down to it by a single countersunk screw.

Footplate or Cab Deck

This is merely a piece of 16- or 18-gauge steel plate 9 in. long and $4\frac{1}{4}$ in. wide, with a piece cut out of it, so that it clears the ashpan. The side valances are straight bits of $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. angle, riveted on at $\frac{1}{8}$ in. from the edge. Note: before erecting this, take out the screws holding the reverser stand to the top of the drag beam. Slide the footplate under it, set same in position, then drill screwholes in it, using those in the stand for guide, and replace screws. This makes a neat job, as the footplate doesn't need cutting to clear the stand; also, it holds the footplate very firmly in position. A single 6-B.A. countersunk screw will be sufficient to hold down the other end, or two or three smaller, if you so desire. The front end of the footplate can be supported at each side by a small bit of angle screwed to the outside of the cradle; no drawing is needed for that simple job.

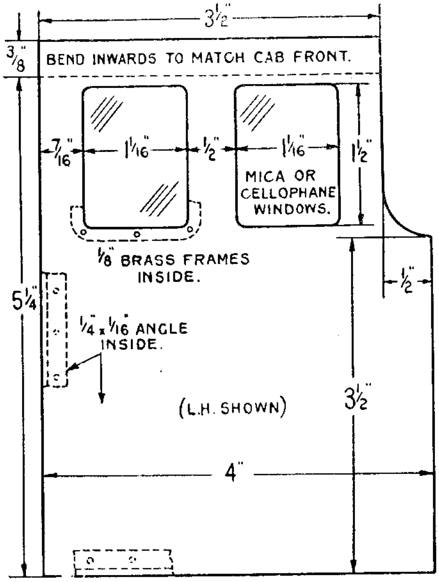
Cab Sides

An illustration of the cab front, with dimensions, was given along with the view of the backhead fittings; this shows that the front is made in three pieces, owing to the great height of the firebox shell. The top piece is attached to the boiler by a piece of angle in the middle. It won't hurt to tap 9-B.A. screwholes in the boiler, as long as a smear of plumbers' jointing is put on the screws before screwing home. The side pieces are attached to the footplate by angles at the bottom, and to the cab sides by more angles, as shown. Cab side, and front portion corresponding, may be made up as a permanent unit. The windows are just holes in the cab front and side, with $\frac{1}{8}$-in. brass frames cut to same outline, and riveted over the holes, with a piece of thin sheet mica or cellophane between, to serve as a glass. I use either bits of domestic pins, or very thin wire, for jobs like these, where regular rivets would make the job appear clumsy.

The cab sides are cut from 18- or 20-gauge sheet metal—which, incidentally, is actually *thicker* than that used on *full-size* spam cans; one of the reasons by which they collected their nickname. Personally, I favour hard-rolled brass, which not only resists dinting and doesn't warp, but takes paint very well; but sheet steel, or even heavy-gauge tinplate (which is really sheet steel with a protective coating) may be used. All sizes are given in the illustration. Note that the tops of the cab sides are bent inwards for $\frac{3}{8}$ in., to match up with the curve of the top of the cab front. These extensions obviate the need of a separate piece of angle, for the attachment of the cab roof. On certain of my own locomotives, *Tugboat Annie*, for example, I carried this idea a step farther, by marking out that piece of the cab front which joins the side, as a forward extension of the latter; so that when this extension was bent at right-angles to the side sheet, I had the side and part of the front as one unit, requiring no corner angle, and no separate bottom fixing for the front piece. On *Jeanie Deans* I carried it to its logical conclusion, the front and both sides of the cab being in one piece.

The sides of the cab are attached to the footplate by pieces of angle of $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. section,

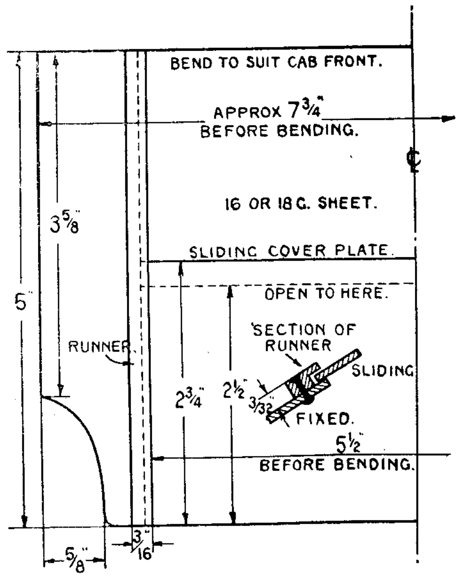
riveted along the bottom of each side sheet, and screwed to the footplate by 3/32-in. or 7-B.A. screws. As the pieces of angle forming the valances come directly underneath, it would be best to put the screws in from the top, as the holes can then be tapped through the thicknesses



Cab side

of the footplate and valance angle combined. Drill the clearing holes in the angle first; then place the cab front in position, and use an extension drill to run through the holes in the angle, and make countersinks on the footplate. I have a goodly array of these extension drills, made by fixing the broken end of a drill, or a drill worn short by frequent grinding, into the end of a piece of $\frac{3}{16}$-in. brass rod of requisite length. In the present instance, it would have to be long enough to stand above the cab side, so that the chuck of the hand-brace will clear. Remove cab side, drill the countersinks No. 48, tap 3/32 in. or 7 B.A., replace cab side, and put the screws in. For this I use another home-made gadget, a long screwdriver made from $\frac{3}{16}$-in. silver-steel, hardened and tempered to light blue, and magnetised by being left in contact with a powerful permanent magnet which once formed part of an old motor-cycle magneto. When the blade of this is placed in the slot of a steel screw, the latter sticks to it like glue until pulled away, and it is a simple matter to put screws in any awkward corner. If I have a *brass* screw to put in an awkward place, I stick it through the end of a strip of stiff paper, which holds it in the required spot until the first couple of threads are engaged by application of a screwdriver. The paper is then pulled away, and there we are, as the paratrooper remarked when he landed in the middle of a duck pond.

The roof is of the "sunshine" pattern, having a central sliding section to allow of easy access to the handles on the footplate. Use the same kind of sheet metal as for the cab sides; a piece 5 in. wide and approximately $7\frac{3}{4}$ in. long will be needed. Make a paper pattern, or measure with a wire, and get the exact length before cutting the sheet metal, so that there will be no waste. Cut away the corners as shown, then cut an opening $5\frac{1}{2}$ in. wide and $2\frac{1}{2}$ in. deep, in the end with the cut-away corners. At each side of this, rivet a runner 5 in. long. It can be made from a piece of 3/32 in. $\times$ $\frac{3}{16}$ in. brass strip, with a $\frac{1}{16}$-in. rebate planed or milled the full length. Tip: when I do a job of this sort, I solder the strip to a piece of much heavier bar, say about $\frac{3}{8}$ in. square, which is held in the machine vice on the milling machine. The weeny-weeny "scale size" angle and tee stiffeners on the roofs of *Grosvenor's* and *Jeanie Deans's* cabs were done that way. If you have no planing or shaping machine, nor a miller, there is no cause for fretting. Just cut a strip of 20-gauge metal $\frac{3}{16}$ in. wide, and another $\frac{1}{8}$ in. wide, but a little thicker, 18- or even 16-gauge. Put the narrower one on the cab roof at 3/32 in. from the edge of the opening, and tack it with solder. Put the



Cab roof

wider one over the top of it, flush with the edge away from the opening, and tack that too. Then rivet through both of them, and the cab roof, with bits of domestic pins. Did I ever tell you that somebody telephoned me one night, and said he had been trying to buy some "domestick" pins, and nobody had the foggiest notion what they were?

The cab roof is next bent to the contour of the cab front, and is then attached to the bent-in upper edges of the cab sides, by a few countersunk

screws, or roundheads, just as you fancy. Four 3/32-in. or 7-B.A., or six 8-B.A. if you like, would do nicely ; but as the metal is too thin to take a thread, the screws must either be nutted, or a strip of 3/32-in. metal soldered along the underside of the bend, and the screwholes tapped through the lot. This makes removal and replacement very easy, and the strips are out of sight.

If the curve of the roof is inclined to be a bit cantankerous, and won't sit down nicely on the curve of the cab front, it can be taught good manners by means of a little bit of angle, about $\frac{1}{2}$ in. long, soldered to the middle of the centre part of the cab front. If a screw is put through the cab top into this angle, the top will be pulled down on to the front, and the driver and fireman won't get their hats blown off when *Pamela* starts in to emulate *Lady Vera*. All that then remains, is to fit the slide, and that is merely a piece of the same kind of metal as the top, $2\frac{3}{4}$ in. deep, bent to the same contour as the cab top, and just wide enough to slide easily between the runners.

A small bracket is needed at each side, to support the back ends of the running-boards ; this is merely a piece of $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. angle about $\frac{1}{4}$ in. long, riveted to the cab front at such a height that the running-board is level when resting on it ; see illustration of running-board. Fixing is by a couple of 3/32-in. or 7-B.A. countersunk screws.

No rain strips are needed on the cab roof, as the runners serve that purpose ; and beading around the cab windows is optional. If desired, simply solder a half-round wire ($\frac{1}{16}$ in. or 3/32 in.) around the window opening on the outside, *before* fitting the mica or cellophane " glasses." Real glass can be substituted if desired, and made detachable for cleaning purposes, by using a rectangular piece of thin glass large enough to cover both window openings. Two runners are riveted on the inside of cab, at both top and bottom of the openings ; these are made as described for the roof runners, but large enough to allow the glass to slide easily in the grooves, and approximately 3 in. long. No window frames are, of course, necessary with the sliding glasses. Mica and cellophane windows may also be made detachable in the same way.

A Tapping Tip

FEW jobs the model engineer encounters are more tedious than tapping a number of small holes—in a steam-engine cylinder casting for instance. He knows that if he relaxes his attention and inadvertently gives the tap just that little bit of overpressure—bang it goes! And when he has finished his job of prolonged twiddling without mishap, his wrist feels like that of the individual in a well-known advertisement for small power tools.

Here is quite an easy way that reduces the risk of tap breakage and eliminates fatigue. The sketch explains itself, just remove the side handle—if there is one—from a small hand brace, a size which takes up to $\frac{3}{16}$-in. drills, say ; and grip the frame horizontally in the vice, as shown. Don't grip the tap too tightly in the drill chuck. If it slips when too much pressure is applied, so much the better.

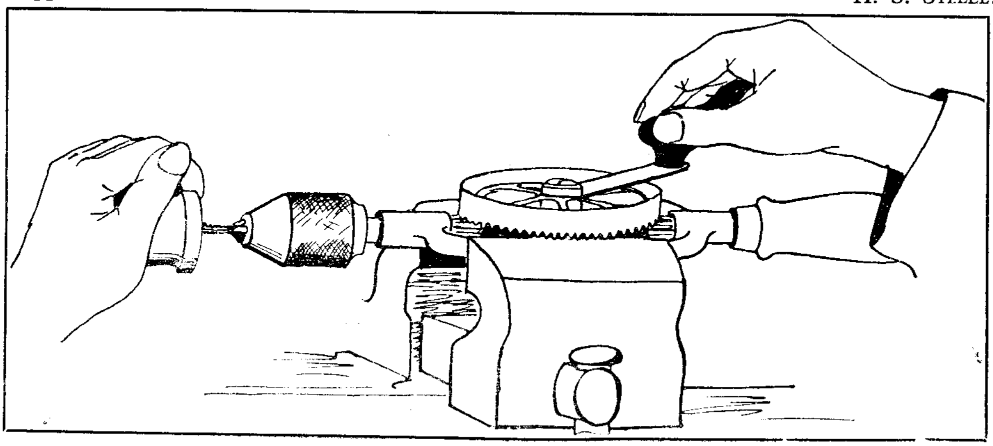
Holding the work in one hand it is easy to gauge its squareness with the tap and a few turns of the brace handle with easy pressure and the hole is tapped. Just reverse direction to withdraw the tap. Use the taper tap first, of course.

This method can be used for tapping sizes between the range of Nos. 8 to 3 B.A. You will be surprised at the ease and facility, the time saved, and the fatigue saved as well.

It is, of course, essential that the correct size of tapping hole is drilled. Even so, with a hole too small, there is less risk of tap breakage, because one gets a much more sensitive feel compared with the use of a tap-wrench, and the slipping feature is a further safeguard.

Just try it next time you have a number of small holes to tap and you will be surprised.

—H. S. STEELE.



Converting a Model Diesel Engine to Run on Steam

by H. R. Langman

THE conversion of a model aircraft diesel engine to run either on steam or compressed air provides an interesting mechanical problem with plenty of scope for inventiveness.

One solution to the problem forms the subject of this article. There are, of course, other schemes and some of these will be considered later.

Many hours of work and scheming were absorbed in modifying the scrap parts, comprising crankcase and cover with seized crankshaft; the cylinder contained a seized piston, apparently not the original one.

It will at once be realised that the engine operates on the "uniflow" principle.

Now for a few constructional features, commencing with the cylinder head and rotary valve. Figs. 1 and 2 show the general arrangement of the parts of the modified engine. Fig. 2 is intended to show more particularly the new parts fitted to the engine.

Referring to Fig. 3, it will be seen that the top of the cylinder *a* is closed by a brass plate *b* to which is sweated a hard brass block *c*; bosses *d* and *e* of the block have passages communi-

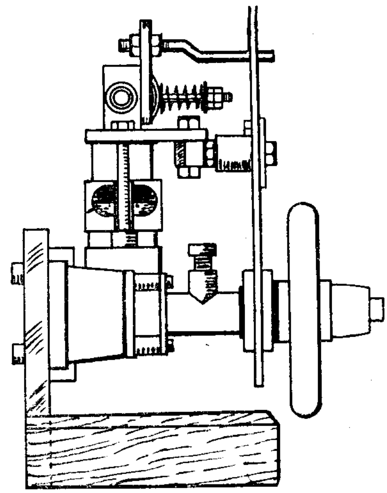


Fig. 1

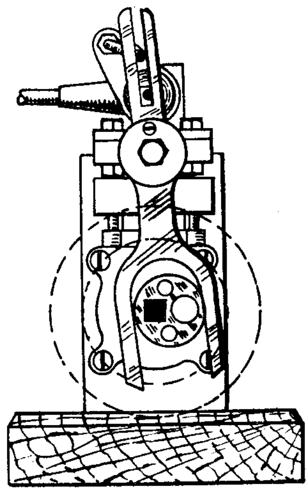


Fig. 2

The first job tackled was to free the crankshaft and piston; next it was decided to fit a new cylinder head complete with rotary valve.

Then followed the evolution of a suitable valve-gear for operating the rotary valve from the crankshaft. On account of the small overall height of the engine, a simple type of valve-gear was essential.

Accordingly, a slotted pendulum lever operated at its lower end by an eccentric was adopted. The upper end of the lever oscillating the rotary valve through the medium of an adjustable arm or pin attached to the valve.

Distribution of the "working substance" to the cylinder is effected by a curved groove in the valve face placing the inlet and cylinder ports in communication during the down stroke of the piston. Towards the end of the down stroke the piston uncovers what was formerly the exhaust port in the cylinder wall, allowing the cylinder contents to escape into the atmosphere.

cating with the ports *f* and *g*, which serve as inlet and cylinder ports respectively.

Ports *f* and *g* are drilled in the side of *c* which is surfaced to serve as a valve face.

The rotary valve *i* cut from brass plate and filed to the shape shown in Figs. 4 and 5, oscillates on the stud *h*.

Leakage between the working faces of valve and brass block is prevented by a compressed spring *j* acting on a dished washer *k* bearing on the back of the valve.

The curved groove *l* cut in the valve face requires careful marking out, since the length of the groove determines the duration of admission of steam, etc., to the cylinder.

The lug *m* of the valve carries a length of threaded rod *n* for engagement with the slotted upper end *s* of the pendulum lever *o* pivoted at *r*. This scheme provides for free movement of the rod *n* in two directions, which greatly facilitates valve setting.

Steam or compressed air enters through *d* via

the drilled port *f* to the curved port *l*, thence through *p* to the cylinder. The nuts *u* provide the necessary tension on the spring *j*.

Fig. 6 shows the elements of the valve-gear, the more important items being the pendulum lever *a* free to oscillate on a 4-B.A. bolt *b* screwed into a brass block *c*; the whole being secured by 4-B.A. bolts *d* to the bottom side of the cylinder cover plate *e*.

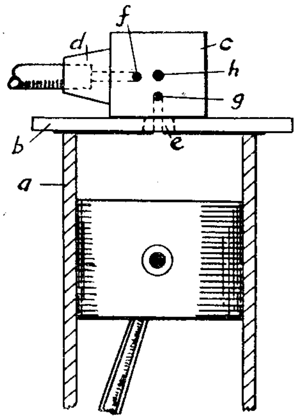


Fig. 3

The lower end *f* of the lever is slotted to embrace the eccentric *g* fitted to an existing square *h* on the crankshaft, formerly intended to receive the propeller. It will be seen that the upper end *l* of the lever has a narrow slot in which works the pin *n* rocking the rotary valve.

The pendulum lever is of mild-steel plate; the eccentric being cut from magnesium alloy bar carefully filed to shape. Lightening holes may be drilled to balance the eccentric.

the eccentric on the crankshaft, and also when setting the rotary valve.

A small brass flywheel clamped between the eccentric and the propeller retaining nut ensures smooth running of the engine. The wheel was formerly fitted to a small stop valve.

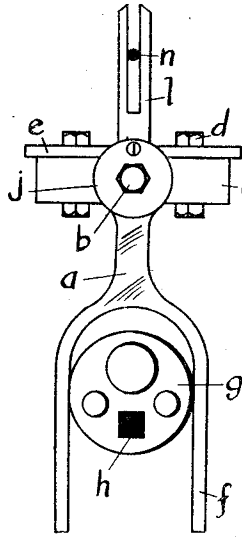
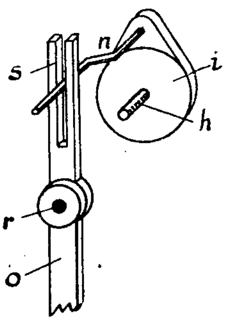


Fig. 6

To avoid building up pressure in the crankcase, two holes are drilled through the wall of the original fuel tank to maintain atmospheric pressure in the crankcase.

If the holes are drilled at the top of the wall, a quantity of oil will collect in the bottom of the



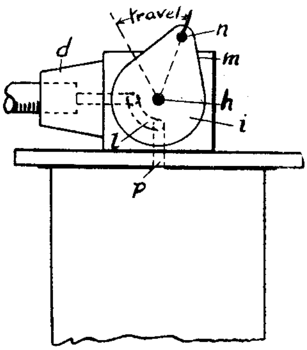


Fig. 4

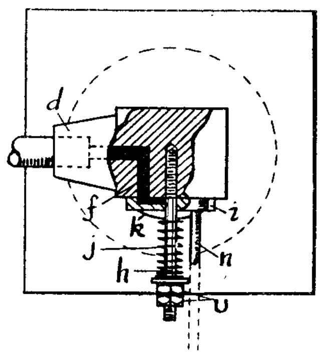


Fig. 5

A small flanged bush *j* inserted and bolted to the pendulum lever supports the latter on the fulcrum bolt *b*.

Since the pendulum lever fulcrum is situated between its ends, it will be realised that the ends of the lever will move in opposite directions; this fact must be remembered when positioning

crankcase and promote splash lubrication of the big-end and cylinder walls.

To exclude foreign matter from entering the cylinder liner through the exhaust port, the finned aluminium outer casing is cut down in length and slipped over the lower end of the cylinder liner. The exposed portion of the liner above the casing

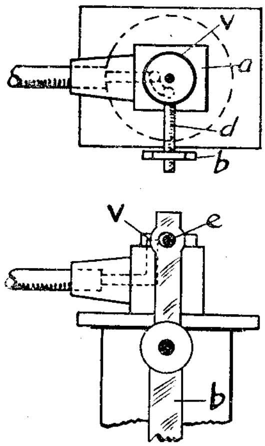


Fig. 7

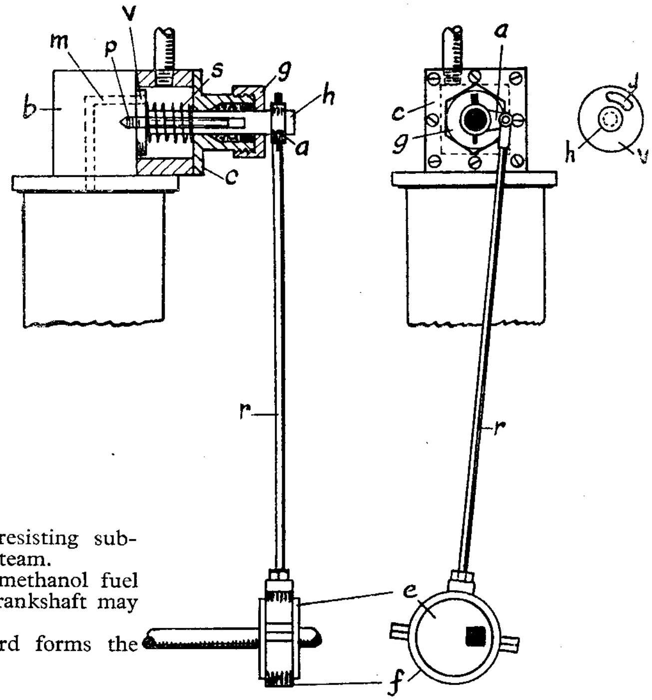


Fig. 8

may be lagged with some heat-resisting substance if the engine is run under steam.

Any holes formerly supplying methanol fuel to the crankcase via the hollow crankshaft may be closed by screwed plugs.

A thin strip of oiled cardboard forms the joint between cylinder and cover.

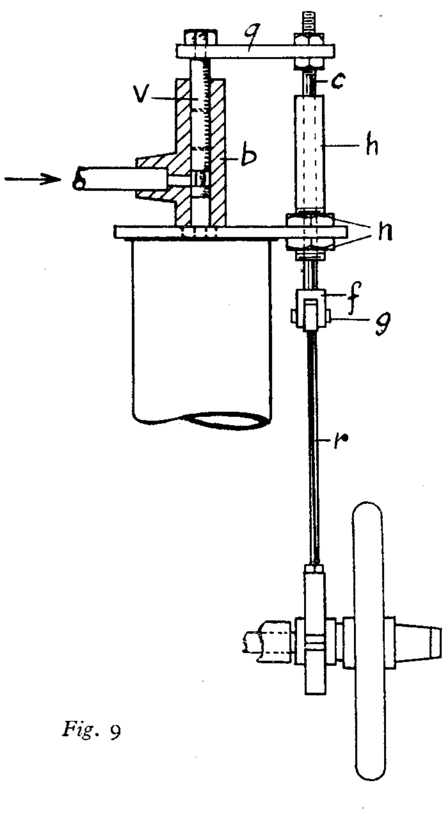


Fig. 9

When running the engine under steam it is very essential to well lubricate the rotary valve to avoid scoring.

Although the valve-gear described in the foregoing notes was fitted, alternatives were sketched out and a few of the more practical schemes may be of interest to readers.

Instead of pivoting the rotary valve in a vertical position, it may be mounted on the top of the steam block *a*, Fig. 7; steam ports being drilled through the block as shown. The pendulum lever *b* instead of being slotted at its upper end for engagement with the pin *d* projecting from the valve *v*, needs only to have a suitably shaped hole *e* to receive the pin *d*.

This will allow for movement of both valve and pendulum lever. An eccentric of required throw on the crankshaft will rock the pendulum lever through the required angle to work the valve for controlling steam to the cylinder.

Fig. 8 depicts a scheme in which a small rotary valve *v* oscillates on a pin *p* screwed into the cylinder block *b*, a light spring *s* slipped over the stem of the valve keeps the latter on its seat.

Since the tubular stem of the valve passes through the cover *c* of the valve-chest, some form of stuffing box and gland *g* will be necessary to prevent leakage.

Attached to the outer end *h* of the valve stem is an arm *a*, the latter being rocked by the rod *r* attached to the eccentric strap *f*. The throw of the eccentric *e* must be sufficient to rock the valve *v* and supply steam to *m* through a curved aperture *j* in the valve *v*; this is shown in the scrap view.

If a piston-valve is preferred, then the arrangement shown in Fig. 9 may be adopted. The steam block *b* being bored and fitted with a snug fitting piston-valve *v*, water grooves may be turned on the upper portion of the valve to minimise leakage.

Since the valve is placed vertically it is capable of being operated by a crossbar *a* secured by lock-nuts to the upper end of the valve spindle *c*.

The lower end of the spindle terminates in a fork end, *f*, jointed by a pin *g* to the eccentric rod *r*.

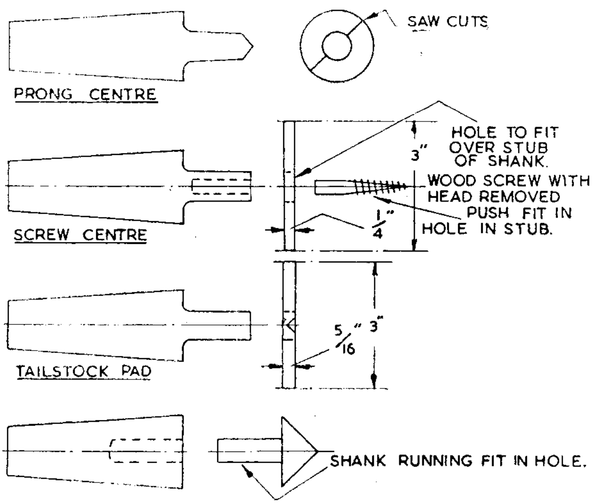
The lock-nuts at the top of the valve spindle provide a convenient means of adjusting the valve in relation to the crankshaft. The valve spindle guide *h* is secured to the cylinder cover plate by lock-nuts *n*

Should a slide-valve be substituted for the piston-valve, then a suitable valve-chest will have to be provided with some form of gland to render the valve-spindle steam tight.

Reciprocating motion for working the valves in some of the schemes described, may be derived from a plunger and spring mechanism, operated by a cam or eccentric mounted on the crankshaft.

WORKSHOP IDEAS AND TIPS

by A. G. Duncan



To many of us who have to think twice before buying those many small items of equipment that make all the difference to the range of work that we can carry out, necessity often becomes the mother of invention.

By making friends with our storekeeper I have been able to obtain several No. 1 Morse taper shanks, the drills or reamers of which they formed part having been broken in use, and from these I have fashioned quite a useful range of tools for my lathe.

The procedure that I followed if the stub was too hard to work was—first softened them by the old dodge of leaving in the fire overnight, then to face up the broken stubs and turn down to a suitable diameter, if necessary, to make them fit the bosses or other parts being made.

A prong centre for wood turning was the first that I tackled, but chucking a stub of 1-in. bar, drilling a $\frac{3}{8}$-in. hole through the centre for about $\frac{1}{2}$ in. deep and parting off $\frac{1}{2}$ in. thick. This "button" was sawn through $\frac{3}{16}$ in. deep across the centre, which was marked before parting off by winding the cross-slide across the faces, the tool just touching Into the saw cut a piece of hacksaw blade was inserted (in each half). The morse taper shank was put into the lathe mandrel and the stub turned down to $\frac{3}{8}$ in., making sure that the "button" was a tight fit and the end made into a 60 deg. point. The "button" hacksaw blade and Morse taper shank were afterwards silver-soldered together, unless I was lucky enough to be able to cut the saw slots just wide enough to allow the pieces of blade to be forced in a push fit and the button being also made a push fit on the Morse taper shank.

Similarly, I made a screw centre. A $\frac{1}{4}$ in. thick, 3 in. diameter disc of mild-steel was silver-soldered to a Morse taper shank in the same manner as the "button," the stub having previously been drilled to take a suitable wood screw, the head of which had been cut off.

Tailstock drilling pads, both plain and V-pattern, for drilling bar and tube, were made in a similar way, together with a set of tailstock centres, square, half round, etc., they being hardened after forming.

A revolving centre is often wanted and a ball-bearing job is an expensive item.

A simple job can be quite easily fashioned in a short time, again using an old taper-shank as the basis. This must be faced down and a $\frac{1}{4}$ in. diameter hole drilled for about $1\frac{1}{4}$ in. deep, and a $\frac{1}{4}$ in. ball-bearing inserted in the hole, after the shank has been re-hardened. Then chuck a piece of $\frac{3}{4}$ in. diameter stock and turn down to shape, (a 60 deg. cone and $\frac{1}{4}$ in. diameter bare shank), case-harden and your revolving centre is ready.

Novices' Corner

Finishing the Ends of Screws and Bolts

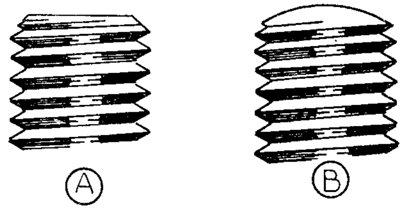


Fig. 1. *A screw with a chamfered end, " A "; and with rounded end, " B."*

THE appearance of an otherwise good piece of work is often marred by the untidy finish of the ends of the screws and bolts used in the construction. It may be that the screws project too far from their securing nuts or from the surface of the work itself and, in consequence, part of the thread is exposed.

This means that the screw is too long for its purpose and will have to be shortened if it is to look right. After the screw has been cut to length, its end will require finishing, either by rounding or by chamfering the flat-faced end, as represented in Fig. 1. Filing the ends of screws held in the vice and finishing with abrasive cloth is not only tedious but seldom gives the correct appearance. The ends of small cheese-headed screws, and, of course, studs, can be given a good finish by mounting the parts in the chuck of a high-speed drilling machine; a fine file is first applied with a sideways rocking motion to form the domed end, and this is followed by finishing with a strip of fine abrasive cloth backed by the file. The final polish can be imparted by pressing the cloth directly upwards against the screw with the finger tip, or with a piece of soft wood, so that the whole surface of the screw's end is evenly pressed on. A large bolt or a countersunk screw cannot, of course, be dealt with in this way, and before any machining can be undertaken it will be necessary to devise some means of mounting the part in the lathe.

Mounting Screws and Bolts

Countersunk and other forms of screws can be held in the three-jaw chuck by employing a split nut. The ordinary form of split nut used for gripping threaded parts in the bench vice is shown in Fig. 2A, but a nut required for chucking must be slit with a hacksaw in the way shown in Fig. 2B; the lower end of the slit is placed opposite one jaw and, as the jaws are tightened, the two flats adjacent to the upper end of the slit will then close on the work. On no account should force be used when tightening the chuck, and, if a satisfactory grip is not at first obtained, the slit in the nut should be extended to allow it to close more easily. The screw need only be gripped firmly enough to allow light machining cuts to be taken, but an insecure hold will result in the screw being checked so that it runs back into the chuck. Another simple way of gripping a screw in the chuck is to use a plain, split bush of the form illustrated in Fig. 3, and, to allow the chuck jaws to grip correctly, the diameter of the bush must, of course, be greater than that of the screw head.

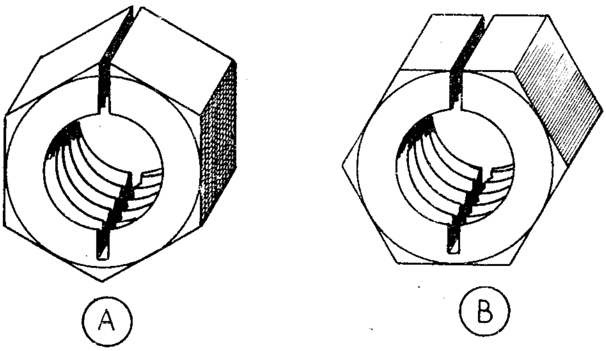


Fig. 2. *Split nut: " A " for holding work in the vice; " B " for use in the three-jaw chuck*

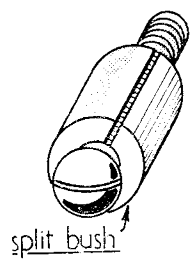


Fig. 3. *Split bush for holding screws*

A Special Chuck

A special chuck for mounting countersunk screws in the lathe is shown in Figs. 4 and 5, and the details of its construction are given in the accompanying working drawings. As this device will so often be found useful, when machining a batch of screws, the following notes on its construction are included.

To obtain true holding, the arbor portion of the chuck should be turned between centres, and the thread is better screwcut rather than formed with a die. The chuck body should be drilled and bored and the angular seating for the

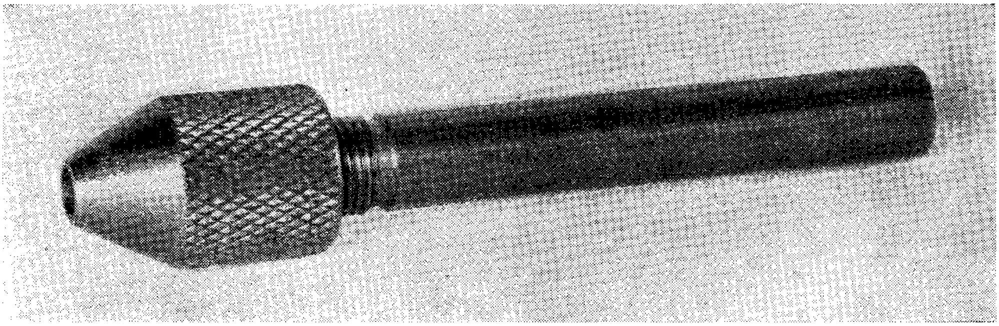


Fig. 4. Chuck for holding countersunk screws

screw heads formed at a single setting in the lathe chuck. The rather awkward job of cutting the internal screw thread in a blind hole of small diameter can be avoided by using a tap supported in the tailstock drill chuck, and, if care is taken, the body should run truly on the arbor with its machine-cut thread.

The body is next knurled, before being parted off to length, and the nose portion is turned to shape with the body mounted on its own arbor.

Although there is much satisfaction in making a true-holding chuck, great accuracy is not called for, as the heads of commercial countersunk screws are not always formed concentric with the shank; moreover, when the chuck is used, the points of screws may be shaped with a file instead of employing a lathe tool for the purpose.

Hexagon-headed screws are much more easily mounted in the lathe, and, if the shank is longer than the total depth of the chuck jaws, the shank itself can be gripped directly while the head portion lies within the body of the chuck. When mounting shorter bolts, however, a nut of the same size as the head is run on to the shank and, as shown in Fig. 7, the chuck jaws are brought to bear on both the hexagon head and the nut itself. In this way, the bolt is aligned sufficiently accurately and, at the same time, it is kept from turning and screwing itself back away from the tool.

Machining the Ends of Screws

Before the screw is mounted in the lathe, an accurate measurement should be made to find out exactly how much shortening is required to allow the screw to project for the correct distance after being machined. This measurement can be made with a rule, and the machining is then carried out with reference to the leadscrew index; however, an allowance must be made for the depth of rounding or chamfering as determined from a standard screw having the correct finish.

Mount Truly

Make sure that the screw, when mounted in the chuck, runs reasonably truly, otherwise the machining of its end will be eccentric and unsightly. After the end has been faced to give the required screw length, the chamfering or rounding operation follows. Chamfering can be carried out with a V-pointed tool mounted in the ordinary toolpost, but the heavy chamfering given to large bolts is done more easily with a tool, ground to an angle of 45 deg., and mounted in a back toolpost. Should chatter develop as the cut broadens, the lathe speed must be reduced, and, for heavy chamfering, the back gear may

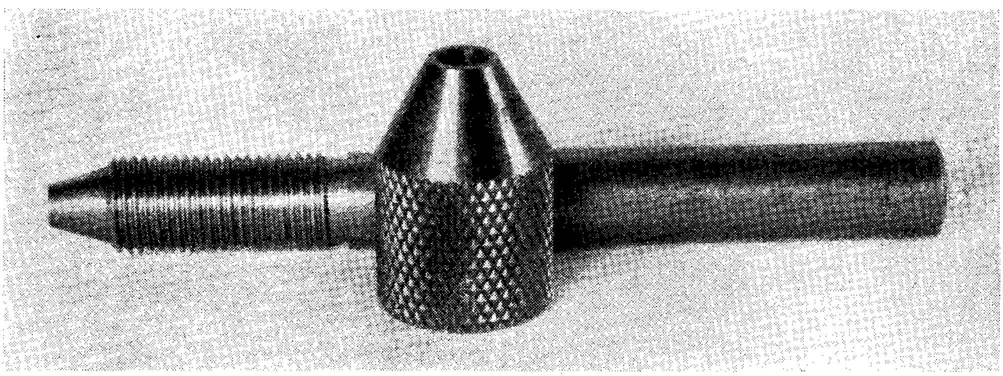


Fig. 5. The chuck components

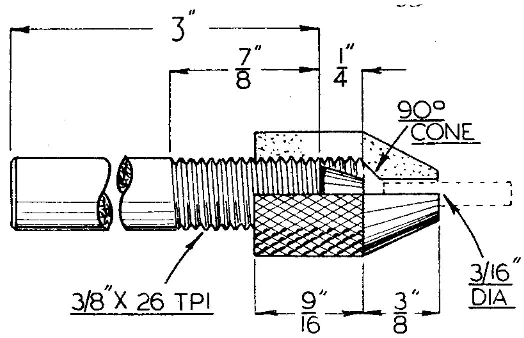


Fig. 6

be required to obtain a good finish on the work. Some workers rely on rounding the end of a bolt with a file while the work is rotating, but a more workmanlike finish will be obtained if a special form tool is used for this purpose. Although the radius of the curvature machined need not have any exact value, it should, for the sake of appearance, vary somewhat with the size of the bolt ;

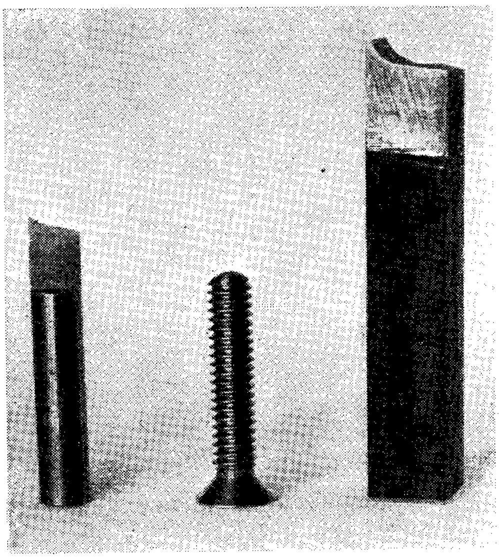


Fig. 8. *Left—tailstock cutter for rounding bolt-ends. Right—lathe form tool*

two or more form tools of different sizes will, therefore, be required for ordinary work. These form tools, for use in the lathe toolpost, are made of square tool steel, cross-drilled to form the required curvature. The cutting edge is afterwards given the necessary clearance with a smooth, round file and, after the tool has been hardened and tempered, the cutting edge is finally sharpened with an oilstone gouge slip. The lathe tool illustrated in Fig. 8 is left-handed and must be set parallel with the lathe axis like a boring tool,

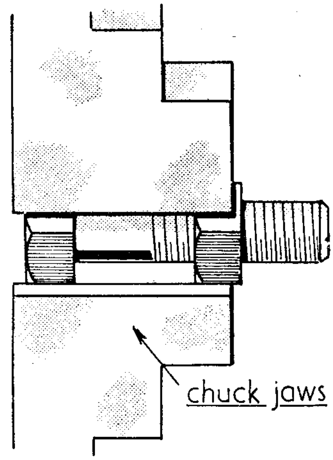


Fig. 7. *Method of gripping a hexagon bolt in the three-jaw chuck*

but it is more usual to make these tools right-handed so that they can be used in the same position as ordinary lathe tools. However, it may be found more convenient to make the tool of round silver-steel and to mount it in the tail-stock drill chuck ; a cutter of this pattern is shown

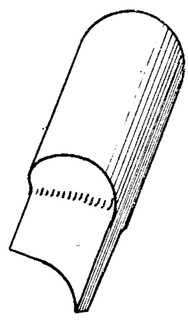


Fig. 9. *Showing the form of cutting edge for rounding bolts*

in Fig. 8 accompanied by a screw which has had its end rounded with this particular tool. To make the tool, the material is first filed down to the diameter line, as in making a D-bit ; the curved cutting edge is then formed with a round file, taking care, meanwhile, to provide adequate clearance along the whole length of this edge, by applying the file at an oblique angle and not squarely across the tip of the tool. After the cutter has been hardened and tempered in the usual way, the curved cutting edge is sharpened with an oilstone slip and the upper surface is polished on a flat oilstone, but care must be taken not to reduce the height of the cutting edge below the diameter line, or the tool will form a pip on the end of the work.

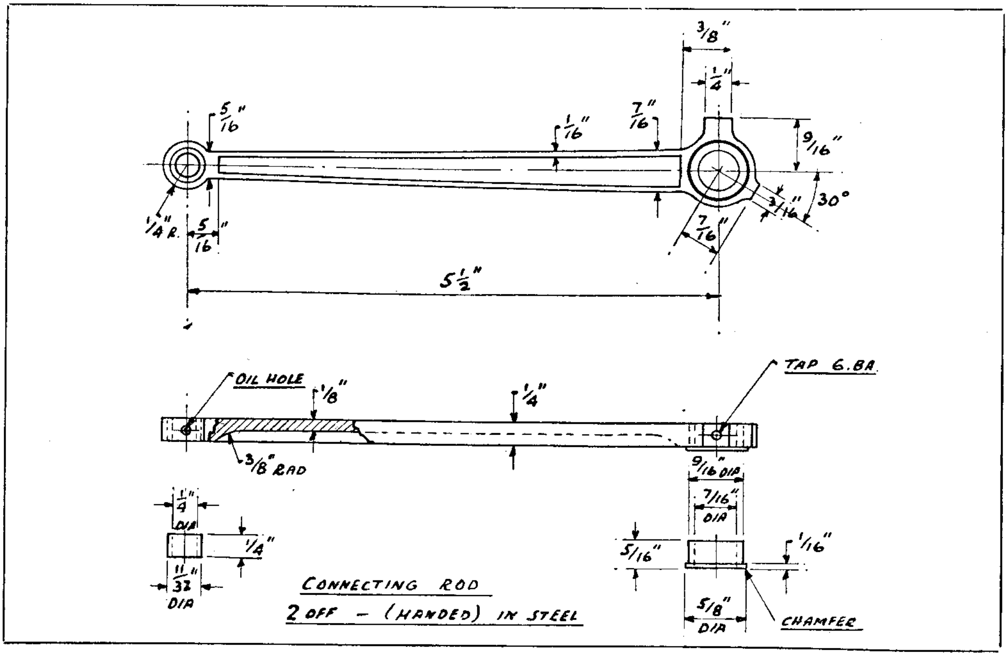
*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

I'M sorry about the rather long holiday in the series. I wonder how many of my good readers realise that I have to do something to earn money, as well as make small locomotives? On top of this, there is always the old health problem, and my working day has become more and more reduced and restricted in recent months, for this very reason.

Since last I went to press, the metal market generally has done the most unkind things to us folk. My overseas mail has been most depressing of late, and I do not know how many times I have been asked to supply a detailed list of all boiler material before the rising costs of copper tube and sheet make locomotive building the privilege of the rich man alone, and as for gun-metal castings containing tin at £1,000 per ton, well, I ask you!



But now I have come back to this kind of work with renewed energy, and the hope that there will be no need for any cessation of work for some time to come. Friend Duncan was becoming a bit restive, and he too, is a busy bloke and even now has not quite caught up with me; I wonder how many builders are right up to date with everything so far detailed?

As I have said once before, I must always keep some way ahead of the series, and this state of affairs has been maintained in spite of everything; even more important than this, the work done is of a very satisfactory nature; the wheels go round as planned, and the compressed air test cannot be more than a few issues away, which means—sooner or later—that the boiler will have to be tackled.

I have had one letter from a Mr. A. J. E. Ffrost, of Melbourne, Australia, thanking me for the list of boiler material I had previously sent him. His letter was of great interest to me, although I sensed a certain sadness in it, and of which he was most probably not aware. He says, "I had great difficulty in getting the 4½ in. stuff (boiler barrel), but got the only small piece in Melbourne; plenty of long stuff, but they will not cut it." Is this a sign of the times, I wonder? He goes on to say—"I have nobody to show me anything or give me any help. I am just plodding along in the dark and unmaking the work when I find out my mistake."

There are, of course, plenty of men "plodding along in the dark"—myself included, and I feel sorry for them—myself included again. However, I happen to know that there is more

*Continued from page 421, Vol. 103, September 14, 1950.

than one "Twin Sister" being built in Melbourne, so hullo there—you Melbourne men, what about getting together and helping one another out? Maybe you could do with some advice yourselves, and sharing out ideas does a world of good at times. So cheer up, Mr. Ffrost, help may be on the way soon.

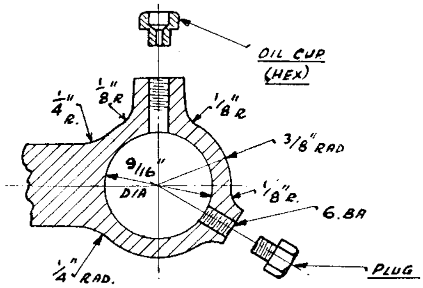
In case anyone else has a mind to do some advance buying of boiler material, here is the list:—

Boiler barrel. 1 ft. 0 in. × $4\frac{1}{2}$ in. o.d. Solid drawn tube, 13- to 10-gauge. (This could be rolled up from sheet material as an alternative to the tube.)

Outer firebox wrapper, 18 in. × 6 in. × $\frac{1}{8}$ in. copper sheet.

Inner wrapper, 16 in. × 5 in. × 13-gauge copper sheet.

Tube plates. 2 ft. 0 in. × 6 in. × $\frac{1}{8}$ in. or 5/32 in. copper sheet.



Scrap Section of Big-End

Foundation ring. 2 ft. 0 in. × $\frac{3}{8}$ in. square copper bar.

Tubes. 24 ft. 0 in. × $\frac{3}{8}$ in. o.d. × 20-gauge; 6 ft. 0 in. × $\frac{3}{4}$ in. o.d. × 18-gauge; 6 in. × 2 in. o.d. × $1\frac{1}{2}$ in. i.d.; 12 ft. 0 in. × $\frac{7}{16}$ in. o.d. × 18-gauge.

Plus rod material for making up into short stays—$\frac{3}{16}$ in. diameter copper wire or rod.

On top of the boiler material, one might as well include sheet brass for cab, side tanks, and other bits and pieces. These will be mainly in 16-gauge, although sheet steel of the same gauge would do well for the running boards and perhaps the cab itself. I recommend brass for the side tanks because of the rust problem, and also because the joints will have to be soldered for water-tightness. Those who are able to get *tinned* sheet steel should be reasonably well off and free from worry, and this material would do for *all* the plate work. But as for the *exact* quantity required, I am afraid I have not been able to work out the figures accurately. At a guess, I would say one sheet, 4 ft. × 2 ft., which, even if short of the required quantity, would go a long way.

Now we can get on with some constructional details; they include the connecting-rod, cross-head, guide-bars, and motion-plates.

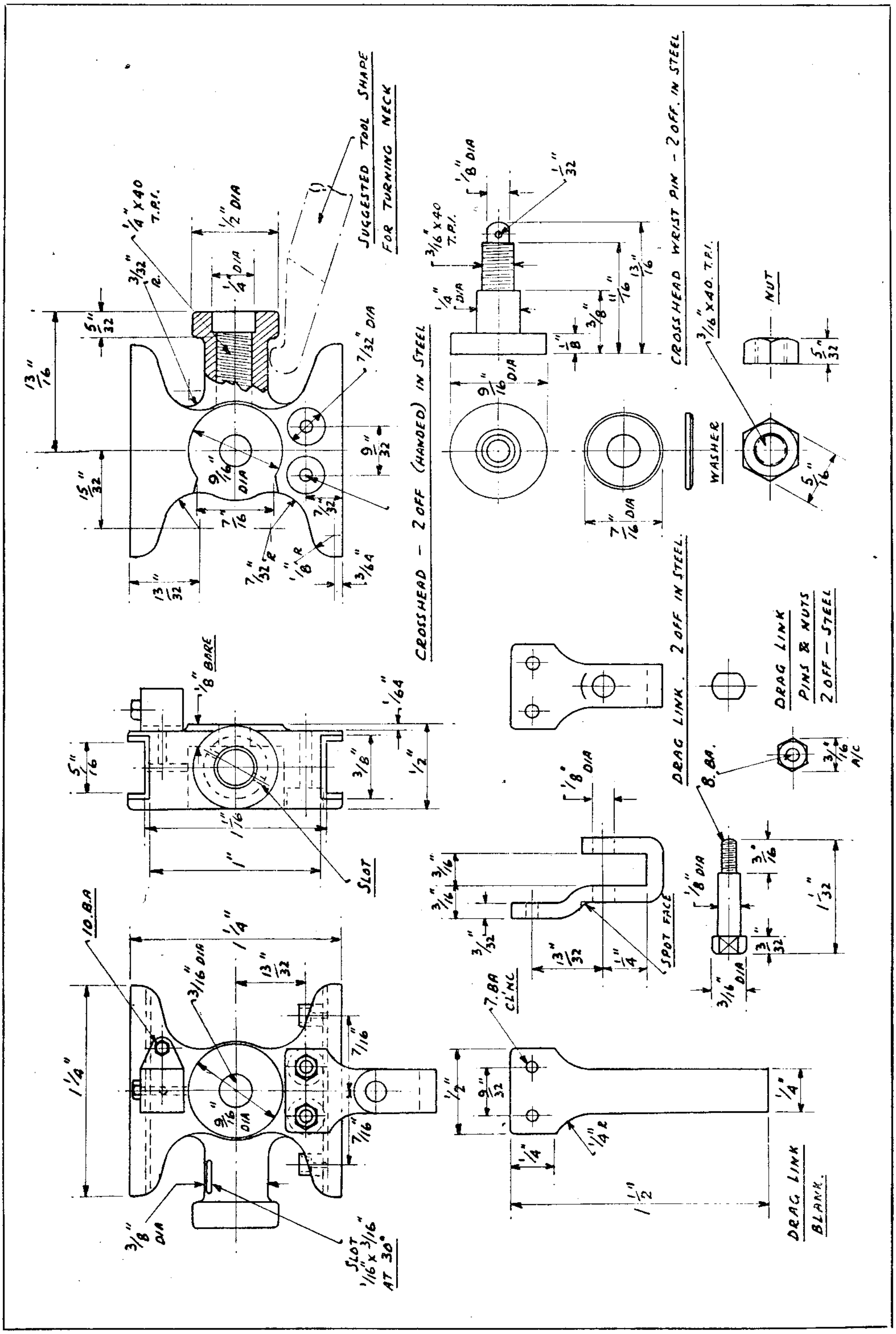
The connecting-rods follow closely on the lines of the coupling-rods, with the exception of the fluting—and *what* an exception! I promised that I would help out with an idea or so on the subject, so off we go.

Taking first of all the men with plenty of equipment, and a milling machine, plus a rotary turntable to go on it, the course open to them is fairly obvious, but in case it is not, this is the drill: Take a piece of steel plate, about $\frac{1}{4}$ in. thick and a bit longer than the coupling-rod, and bolt it centrally to the face of the table. Drill and tap a couple of $\frac{1}{4}$ in. holes in the plate so that fixing studs may be passed through both eyes of the rod, to hold it down. Set up the fluting cutter in the arbor of the machine (horizontal) so that it will come in reach of the work, which generally means holding a Woodruff type of cutter in a large Jacobs type of chuck, placed in turn in the main arbor socket of the machine.

Now rotate the milling table until one of the sides of the connecting-rod lies parallel with the path of the cutter, and note the exact position of the table, either from its direct side reading, or from the thimble behind the handle, which is usually 3 deg. per complete turn, or three lots of 60 minutes of markings.

Now do the reading when the rod is slewed round to bring its other side in the path of the cutter; these are your two numbers to note. If the machine is fitted with stops at both ends of the main travel table, then these too, can be set according to the length of flute required. Start with a plunge cut to the required depth as shown on the drawing, at one end of the rod (preferably the narrow end) and correct the stop if the flute is not starting soon enough. The other stop should be friction-tight so that it can be pushed along when the travelling stop reaches it, and when the cut is taken along at full depth down one side of the rod, the stop will be "felt" on the handle, and will not be disturbed when the job is wound back to the start, when the second stop can be finally tightened. If the machine has a reliable thimble on the height adjustment, which determined the exact depth of cut, then this number should also be noted, so that the work may be dropped away from the cutter when placing the rod in its second position. It is just as well to do this the first time, when one is not sure how the cutter will respond to side cutting, or the movement of the work in relation to the turning of the table under the cutter. Once the position has been found, then a fresh plunge cut may be taken against the first stop, and the main table wound up to the number noted on the rise and fall handle. You should have a couple of grooves running true to the two sides of the taper rod, and the milling out of the unwanted material between them is only a matter of getting the rotating table in a mid-position between the two extreme numbers noted, and winding the handle back and forth.

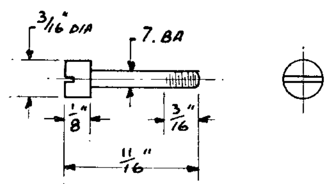
If the cutter has good cutting teeth, and the correct lubricant has been used, the resulting flute should hardly need touching at all. In case of any slight ridges or ripples in the base of the flute, a small rifling file *used without cutting fluid* will bring the job to a very fine finish indeed, and without the tell-tale blurring over signs usually left by emery-cloth.


SUGGESTED TOOL SHAPE FOR TURNING NECK
CROSSHEAD – 2 OFF (HANDED) IN STEEL
CROSSHEAD WRIST PIN – 2 OFF. IN STEEL
NUT
WASHER
DRAG LINK. 2 OFF IN STEEL.
DRAG LINK PINS & NUTS 2 OFF – STEEL
DRAG LINK BLANK.
SLOT
SPOT FACE
SLOT 1/16" x 3/16" AT 30°
10.B.A
7.BA CL'NC
8.BA.
1/8" BARE

Perhaps you have everything but the rotating table, in which case you can still retain the fixing plate, but with one stud a good fit in the little-end of the rod, thus making it a sort of hinge pin, and the other a very sloppy fit in the big-end of the rod. This will enable you to swing the rod from side to side to an extent that will permit of the rod being clamped in a position to bring it in line with the cutter. This you will have to do by trial and error, running the table along with a test indicator bearing on the side of the rod being set. This way will take a little longer, but the result will be quite as good as that obtained by the first method.

The plate method will work equally well as when set up on the vertical slide of a lathe, except that, with the lesser rigidity of the set up, the full depth of the cut will have to be taken far more slowly. In other directions, the procedure is exactly the same as for the milling machine "luxurists" (nice word, that).

Builders of "Minor" will be allowed to leave the rods plain, and even to exclude the lower lug on the big-end of the rod. What is this extra lug



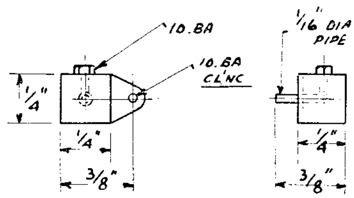
DRAG LINK BOLTS WITH 8.BA. NUTS.
4 OFF — IN STEEL.

for, anyhow? On the big job, it is a combined "keep" and pocket for the pad oiler; it is, after all, the hardest worked bearing on the engine, and deserves some consideration.

The crossheads come next which, incidentally, spoil nine out of ten engines put on show when it comes to correct shape and proportions. I have always been sorely puzzled about this strange phenonenon, and tried to work out whether the builders just did not know what the shape *should* be, or whether they were afraid the correct shape would be too difficult to make. I present you, therefore, with the correct shape of crosshead *in detail*, and how it should be made; and, by the way, it is no harder to make than the usual cross between a Maltese cross and an-honest-to-goodness square block of steel with a hole in one end of it. Anything that will slide between the guide-bars accurately and provide a true housing for the piston rod end, will do the job; but it will not be according to the prototype, so let us do the job properly.

As an elementary beginning, prepare a block of steel the exact overall dimensions of the crosshead, and mark out the profile on one face; all this can be done with the aid of a four-jaw chuck on the lathe. Now mount the block in the chuck, with the neck portion outwards, ready for machining. Needless to say, the block should be set up so that it is quite true, and may be tested by putting a dial or gauge in the slide-rest when all four corners of the projecting portion of the block should move the indicator to an equal extent.

Now grind up a tool as shown in the text of this issue, making sure that the "heel" of the tool is well ground away underneath, just as you would for a boring-tool bit to work in a small hole. Run the lathe slowly and take small cuts,



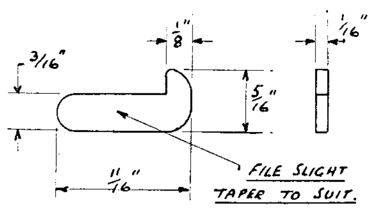
OIL BOX. 2 OFF (HANDED) IN BRASS.

and on no account *rush the job*. Stop the lathe at frequent intervals to inspect progress. Feeds for the parallel portion of the neck may be taken by sliding the saddle, and if the top-slide of the lathe has been set to give the angle at the bottom of the slipper portion, the tool can stay put, undisturbed.

Eventually you will get the job to the desired outline, and having done so, centre the neck, drill, tap $\frac{1}{4}$ in. $\times$ 40, and open out a little way to the full $\frac{1}{4}$ in. diameter. After this, the back or blunt end will provide no headaches at all, and you should be able to whistle, sing or hum simple tunes whilst carrying on with the job!

Next, we come to the faces of the crosshead, and with it, a warning. The thickness of the block should allow for the front face being turned down to leave the centre raised boss as shown, which makes all the difference to the look of the job.

This is the only machining done on the front, and is best left until after the back has been done, for a reason you will soon know. Holding the work in the chuck once more, and with the



COTTER. 2 OFF. IN STEEL

same regard for true concentricity or centralisation, you can now centre, drill, and bore out the back pocket to dimensions given.

If these pockets are made equal in diameter (and they *should* be, of course) they can in turn be mounted on a simple spigot turned up in the three-jaw chuck, and the front face of each part machined so as to leave the raised boss mentioned. This method will also ensure the boss being truly central with the drilled hole.

(*Continued on page* 152)

IN THE WORKSHOP

by "Duplex"

*No. 81—Constructing a Paint Gun

THE T-shaped central portion of the body, Fig. 7A, is made from a piece of rectangular brass bar of a suitable section. The work is first marked out, and then set up in the 4-jaw independent chuck, in order that the spigot into which the paint tube is screwed may be machined to the dimensions shown in the drawing. If preferred, the short spigot marked X may be made as a separate part, and, later, sweated into the T-piece.

When the spigot has been machined, the work is removed from the chuck, and replaced with one end of the horizontal portion projecting to enable it to be turned and bored to receive one of the two tubes which make up the body. The work is then reversed and the other end of the horizontal portion machined in the same way.

When the T-piece has been completed, the two tubular extensions may be made, pressed in, and, if thought necessary, sweated in place; but this is not an essential operation if the tubes have been made a good press fit. If sweating is considered to be desirable, then one of the solder paints now on the market will be found useful here, for they enable a neat joint to be made. Care must be taken, however, to avoid a lavish application of the soldering composition or the results may be most untidy.

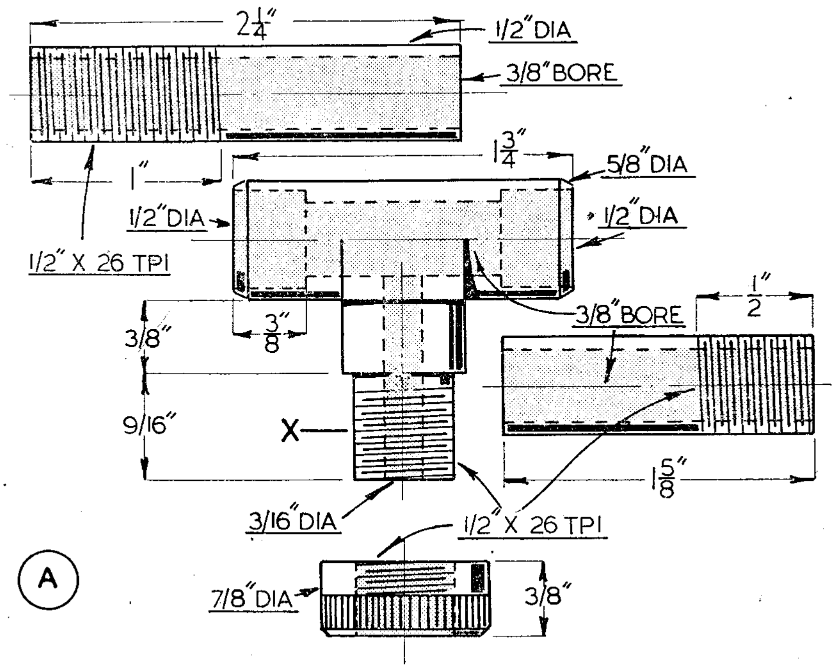


Fig. 7A. The body

The threads on the tubular extensions must be accurately cut, and should be formed in the lathe by a screw-cutting process, as the use of a tailstock die-holder is unlikely to produce threads of sufficient accuracy. These remarks apply, in particular, to the end of the body upon which the combining cone is mounted. It is inadvisable to make the extensions from tubing, for the bore and outside diameter of these parts must be concentric. They must, therefore, be machined from brass bar to the dimensions given in the drawings.

The Combining Cone—Fig. 7B

The threads in this component should be cut

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*Continued from page 66, "M.E.," January 11, 1951.

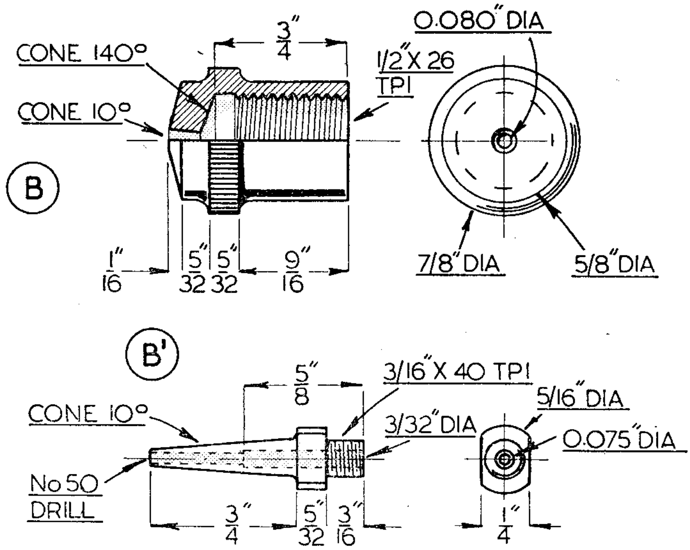


Fig. 7B and 7B¹. Details of combining cone and air nozzle

in the lathe to ensure that the cone screws truly upon the body. Emphasis has already been laid on the necessity for accurately centring the air nozzle in the body so that it is concentric with the combining cone. It follows, therefore, that the cone itself, must be correctly machined if the relative truth of all these parts is to be maintained. A tap held in the tailstock chuck will normally cut threads which are concentric, but there is always the danger that these threads will be oversize, and that the part will then be a slack fit on the tubular extension.

The depression at the bottom of the cone is best formed by means of a correctly-shaped spade drill, which may easily be made from silver-steel to the form shown in Fig. 8, the angle at the point being ground to the figure given in the drawing. The diameter of this drill is made to a size which will just clear the threads. There is some advantage to be gained from drilling this depression before the work is screw-cut, and in this instance the drill should be made 0.450 in. diameter which is the theoretical core diameter of a ½ in. thread having 26 threads to the inch.

The paint orifice is coned at an included angle of 10 degs., and this is best carried out by holding the part in a 4-jaw chuck. The work may then be set to run truly, and the opening machined with a specially made D-bit of the correct angle, after the cone has first been centre-drilled and then pilot-drilled, so that the point of the D-bit can just enter. From the drawing it will be seen that the small end of the orifice is 0.080 in diameter. This dimension will need to be gauged by means of a No. 46 drill, the size of which is sufficiently close for all practical purposes. The shank of the drill is used as a gauge, and the D-bit is fed into the work until the drill will just pass through the hole.

The Air Nozzle—Fig. 7 B¹

It is essential that this part should be accurately made. This is best ensured by carrying out the bulk of the machining at one setting, after which the work is reversed so that the No. 50 drilled hole can be formed concentric with the cone of the nozzle.

Accordingly, a piece of $\frac{5}{16}$ in. diameter round brass rod is gripped in the chuck and the screwed spigot turned and threaded $\frac{3}{16}$ in. × 40 t.p.i. A 3/32-in. drill is then fed into the work to the depth shown on the drawing. The 10-deg. coned nose is now roughly machined so as to allow but little material to be removed by turning when the work is reversed, after parting-off, and held by the screwed spigot in an internally-threaded adapter, so that the No. 50 drill hole can be formed and the cone finally mached to size. It will be obvious that, owing to the $\frac{3}{16}$-in. spigot being somewhat weak, the turning operation will need to be carried out by using light cuts, with the lathe mandrel running at high speed. It should be noted that it is advisable to drill the No. 50 hole before finally machining the cone. Otherwise the centre-drill used for starting the hole

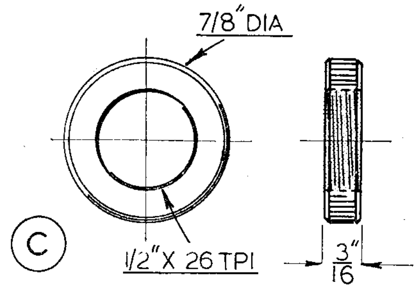
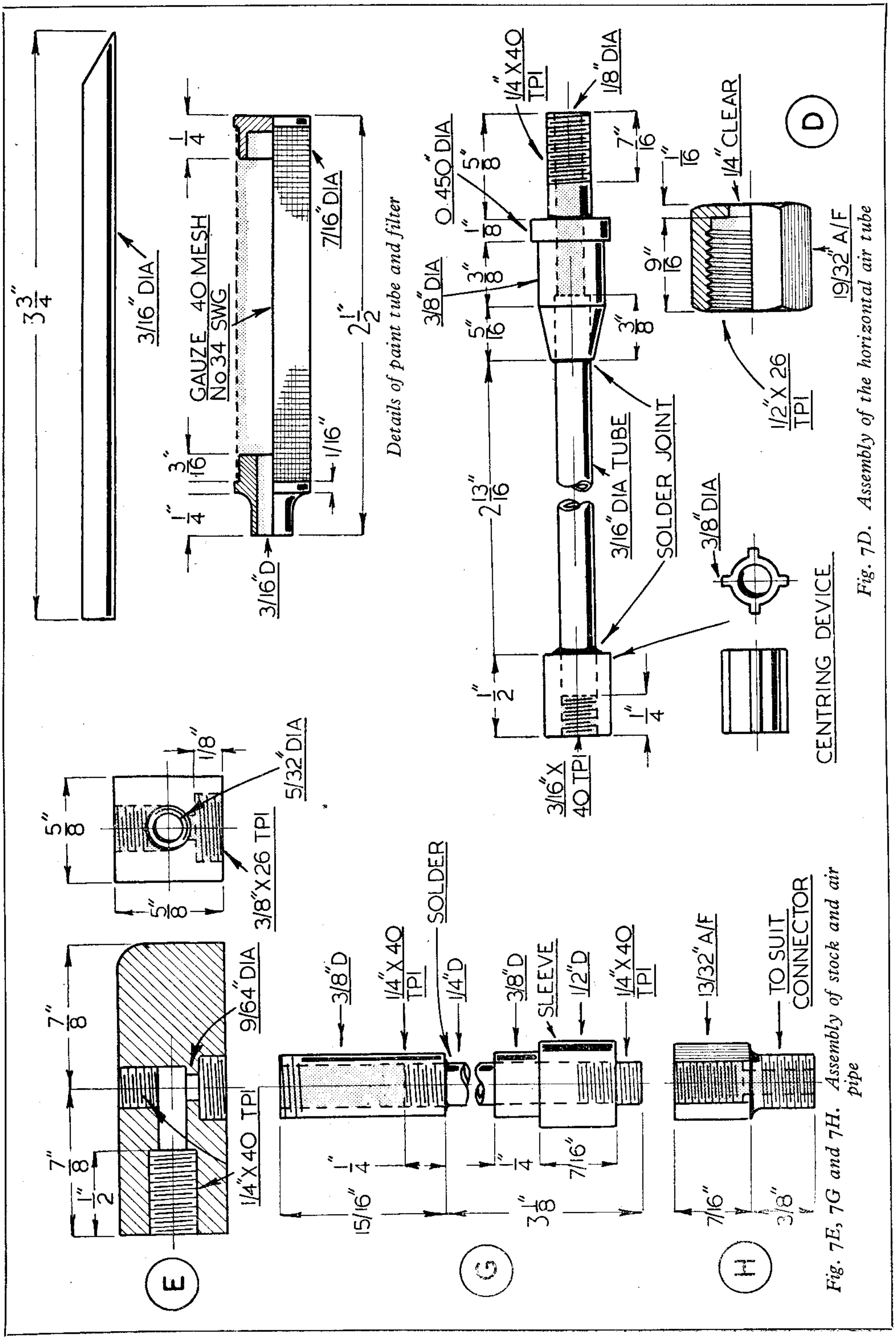


Fig. 7C. The lock ring

may tend to bell-mouth the work and upset the symmetry of the part.

The internally threaded nose or adapter needed for this operation is readily contrived from a short length of brass rod. This is held in the self-centring chuck and has its end faced square. The rod is then centre-drilled and drilled tapping size for $\frac{3}{16}$ in. × 40 t.p.i. with a 5/32-in. drill. A drilling operation is usually of sufficient accuracy in the circumstances. However, should there be any doubt upon the matter, it is better to bore this hole, which may then be threaded by means of the appropriate tap held in the tailstock chuck.



Details of paint tube and filter

Fig. 7D. Assembly of the horizontal air tube

Fig. 7E, 7G and 7H. Assembly of stock and air pipe

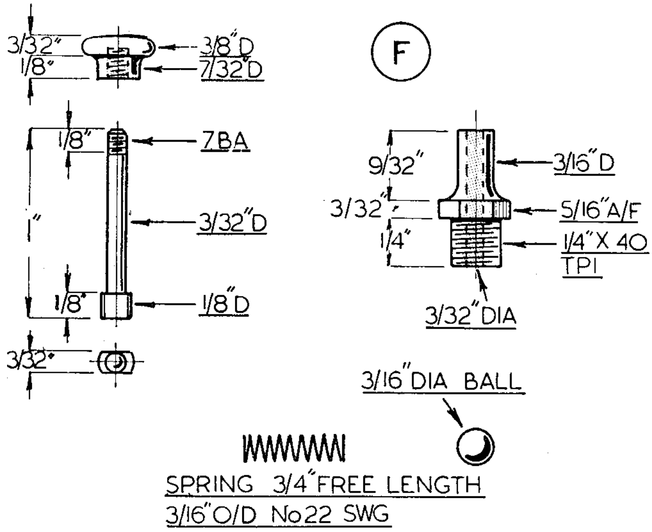


Fig. 7F. Details of the operating valve

When the threading operation has been completed, the nozzle is screwed into the adapter so that the operations which have been previously detailed may be carried out.

It should be noted that it is advisable before threading to run a $\frac{3}{16}$ in. drill into the adapter for a distance equal to two or three threads. This will prevent the tap throwing up a burr which, if allowed to form, would set the air nozzle out of centre.

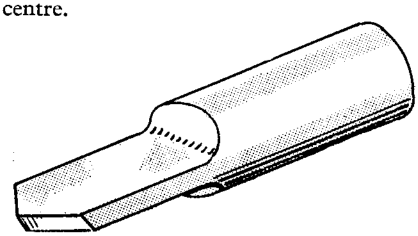


Fig. 8. The spade drill

The Lock Ring—Fig. 7C

The accuracy needed by the combining cone is not required in this component. The part is made from brass bar, and the threading will have sufficient truth if carried out by means of a tap held in the tailstock drill chuck. The knurling on this ring, as well as that on the combining cone, needs to be done neatly; this is work which has been described many times in the past, so requires no detailed comment here.

The Union and Nut—Fig 7D

As has been stated earlier, the union body is made of steel. The nut is turned from hexagon brass bar 19/32 in. across the flats. Suitable methods for machining these parts were described in an article entitled " Pipe Fittings " which was published in the July 13th, 1950 issue. Readers seeking further advice on this matter should refer to this article

The Stock—Fig. 7E

This part is made from a piece of rectangular brass rod. The drilling and tapping needed to accommodate the valve, the operating plunger and the union can be carried out in the drilling machine, though some may prefer to do this work with the part held in the 4-jaw independent chuck.

The Operating Valve—Fig. 7F

The valve consists of a spring-loaded ball housed in the upper end of the main air supply tube G which terminates in the air line adapter H. In order to make the construction clear, a much enlarged view of the device, in section is shown in Fig. 9.

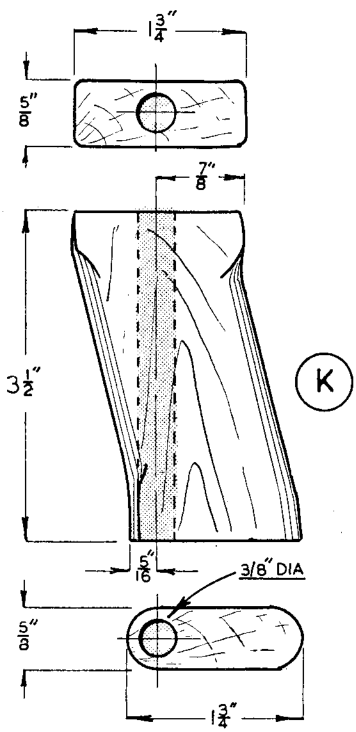


Fig. 7K. The handle

The machining of the parts which comprise this valve requires no comment, for the work is of a simple nature, and full details are given in the drawings of the various components.

It should, however, be noted that the steel ball needs to be properly seated on the rim of the hole leading into the stock. This is best

ensured by placing the ball over the hole and giving it a smart tap, a brass drift being interposed between the ball and the head of the hammer. The seating thus formed may then be inspected with a magnifying glass, and it will be found that the ball has made an anular ring at the entrance to the drilled hole. The ball must be struck squarely or the seating will not be concentric and the whole object of the operation will be defeated. It is realised that this is a very elementary point; but many neglect it to their own disadvantage. A badly seated ball valve is of little use in any piece of apparatus; in this instance it will in all probability cause the paint gun to weep, with disastrous effect on the paintwork.

The Handle—Fig. 7K

The handle is made from a piece of hardwood which should be cut roughly to shape, but not finally finished until after the hole for the air pipe has been drilled. It will then be possible to make any correction needed to the top surface which abuts on the stock ensuring that these two parts are square with each other; it will also help the obviate the possibility, by no means a remote one, of the drilled hole running out and leaving insufficient material upon which to seat the air-line adapter.

When the handle has been finally shaped it should be given several coats of french polish; this treatment not only presents an appearance which is pleasing, but it is also a protection against cellulose and other paints.

Assembling the Gun

The assembling of the gun has no problems, but care must be taken to see that the horizontal air tube, which passes through the body, can slide into place easily. This is an important point, for the tube needs to be withdrawn from the gun every time it is cleaned after use. The union body and the centring device should, therefore, be made an easy fit at the time when the parts are being machined.

As the metal parts of the gun are made almost wholly of brass, it is well to impart a good finish

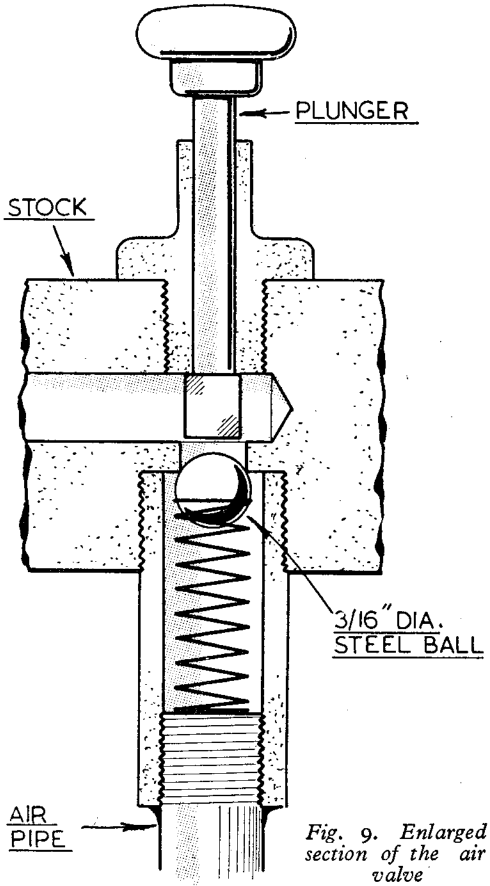


Fig. 9. Enlarged section of the air valve

to them and then to apply a coat of lacquer which will preserve the appearance of the device for some considerable time.

Twin Sisters

(*Continued from page* 147)

Next, tackle the guide-bar channels, using either an end-mill in the lathe, or properly milled in a milling machine, after which some *solid* strips of brass or gunmetal should be silver-soldered in place. When this has been done, the slots should be again milled out to the correct and finished dimensions given. This will leave a very thin slipper of brass inside each slot, which is all that is required, and in any case, we just have no room for a more substantial lining without increasing the dimensions of the crosshead, which, in turn, would spoil its looks and proportions.

Those who are going in for the extra refinements, such as the oil-box on the front face, and the oil-cups on the bottom shoe, might like a word or two. The oil-cups should be in steel, and not brass. On the prototype they are all in one piece with the crosshead which is a steel casting. In this connection also, being a casting, none of its edges (except *machined* edges) are sharp, so you can go all round the profile of the job with a tiny file, gently rounding it off to simulate the casting form. The oil-box on top should be in brass, and if it is fitted with a very small piece of copper tube at the back, it can feed into the main oil-hole from the top slipper, and thus become a real working part. Finally, when putting in the steel oil-cups, these should be silver-soldered in at the same time as the slippers.

(*To be continued*)

A DIAL INDICATOR

by A. D. Stubbs

YOU may say "Yes, very nice, but too expensive for me." Given an old alarm clock, a rummage at a scrap iron dump, and a $3\frac{1}{4}$-in. diameter piece of glass, this one need not cost anything.

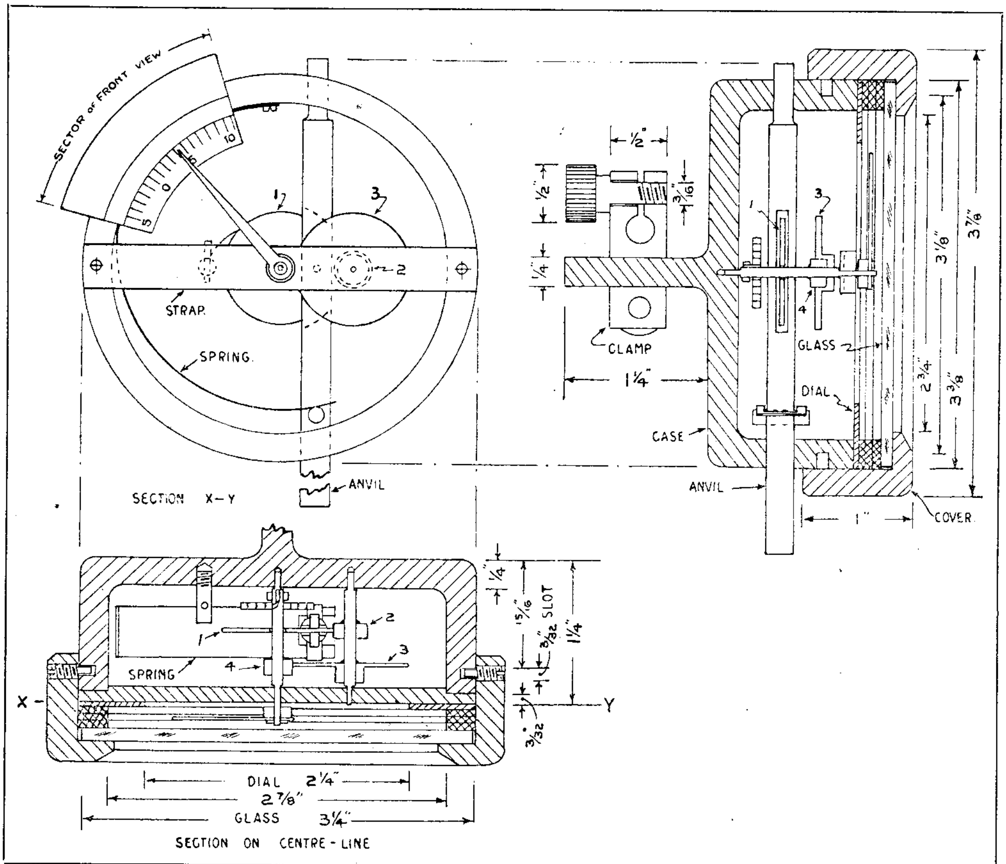
It is highly accurate, enabling readings of 0.00025 in. to be readily made, and in case some readers have already spotted an apparently blatant inaccuracy I had better start right there.

The $\frac{1}{4}$ in. diameter steel anvil, $4\frac{1}{4}$ in. long, has a $\frac{1}{8}$ in. travel, and it is pressed into contact with the work by a $\frac{7}{16}$ in. wide spring. One end of this spring is setscrewed to the case, the other end is softened, cut to a forked end, and re-hardened. The fork spans the anvil and rides on a $\frac{1}{8}$-in. steel pin, $\frac{1}{2}$ in. long.

This spring action is strong enough to ensure that the anvil moves in the case without lag or play, whilst the gear action is loaded by a separate hairspring, this also coming from my old alarm clock.

Before final assembly of the anvil, the hairspring is wound up by giving the central arbor three or or four turns, and it thereafter maintains a load through the gear train, pressing one arm of wheel No. 1 against the actuating pin in the anvil.

Henceforth the slightest pressure on the anvil or, conversely, release of pressure, moves the dial pointer correspondingly. And here is the apparent inaccuracy. I started out by putting a drum on wheel No. 1, my intention being to have a cord on its circumference, the circumference to be in line with the anvil centre line. Several failures due to unsuitable material plus expansion and contraction due to humidity made me scrap that idea in favour of the drive by one arm of the wheel.



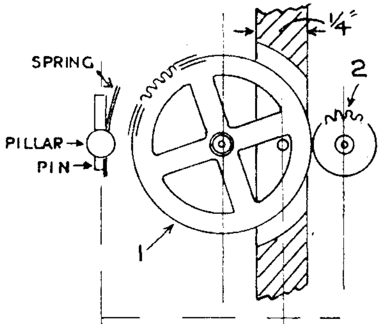
Were the dial machine-divided in equally spaced divisions, the indicator would be inaccurate, as the straight line lift of the anvil is converted into an arc on the wheel.

To overcome this, I hand-scribed the divisions.

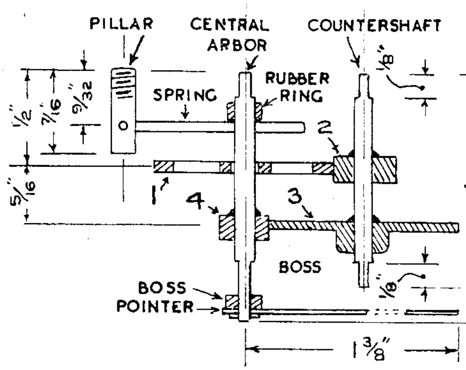
It is intended that the dial zero should normally be used at the mid-travel point of the anvil. The dial is free to rotate through 360 deg., but if zero is set 30 deg. away, the inaccuracy cannot be detected, and it is only 0.002 in. at 180 deg. when the zero is set diametrically opposite its designed position.

As the total magnification of gears and levers is 72, the pointer can travel through more than one revolution. The anvil has definite mechanical stops, and as the gear train and pointer have none, the more delicate mechanism cannot be harmed.

To divide the dial, I set up the finished instrument on my faceplate, face towards the tailstock, and anvil horizontal, with the operating end towards me. A stock piece of L-shaped flat steel was then gripped in the tool clamp, with the leg



SECTION THROUGH ANVIL



of the steel against the anvil and the other angle parallel with and close to the dial which, for this purpose, was assembled outside the glass.

By advancing the cross-slide to contact the anvil, you can use the 0.001 in. divisions on the micrometer dial to calibrate the dial. Take up about 0.015 in. of the anvil travel before you commence scribing, then scribe from the surface of the L steel by thousandths until you completely divide the full dial circle. Zero must be at 180 deg. from your starting and stopping point.

In use, the rotatable dial should be set with the zero coinciding with mid-travel of the anvil.

My dial is brass. To scribe it, I coated the entire surface with a thin film of melted beeswax, by warming the brass, and used a simple scribe to scratch through the film. Immersion of the dial in dilute nitric acid did the rest. Result, good etching, except for my figuring, which looks rather amateurish.

Details of Construction

Having finished the job on paper, we can get down to the construction. I dare not use steel, because I live only a quarter of a mile from the sea, and find that the damp, salt air starts rust overnight, so I made up a pattern, and had the case and cover in cast brass.

The case outside diameter cleaned up to $3\frac{3}{8}$ in., the inside being $2\frac{7}{8}$ in. Internal depth 1 in., base thickness $\frac{1}{4}$ in. The holding stem can be turned to suit any individual holding device, but you will see my clamp action shown in section.

Around the periphery of the case I cut a 3/32 in. wide slot, $\frac{1}{8}$ in. deep, for the cover retaining grub screws, which are $\frac{1}{8}$-in. Whitworth, with threads removed for $\frac{1}{8}$ in. of their length. Right across the top of the case is a brass strap, $\frac{3}{8}$ in. × $\frac{1}{8}$ in., the ends being reduced to 3/32 in., and corresponding slots cut in the case to enable the strap to be sunk to case level.

Having fitted and setscrewed the strap, you can find the alarm clock. I chose the hour/minute hand train, because the 12 : 1 ratio was what I wanted, but I could not work in the clock arbors, so made my own from silver-steel, both 3/32 in. diameter, the ends being reduced to $\frac{1}{16}$ in (Machine scrap at this stage, one arbor.) The full diameter length must be 1/32 in. less than the available $\frac{7}{8}$ in. case depth, and there must be no risk of undue friction in the case bearings.

I left a radius on the $\frac{1}{16}$ in. diameter, and chamfered the case bearing holes and strap holes with a 3/32 in. drill, so the arbors can ride home at both ends.

The spring around the inner end of the central arbor is my alarm clock hairspring. I anticipated a spot of bother here, but apart from scrapping $\frac{1}{2}$ in. through endeavoring to get too acute a bend of 90 deg. everything went according to plan. The inner end of the spring is twisted out axially, to lie along the axis of the arbor, and a rubber ring, once part of a cycle valve rubber, gives a friction drive. The other end of the spring is pinned by its own clock pin to a pillar, $\frac{1}{2}$ in. × $\frac{1}{8}$ in. diameter, screwed into the base of the case.

Having got so far, and ensured that the arbors are free fitting, we can tackle the anvil. Incidentally, a little slackness in the arbor bearings is not vital, as the hairspring looks after that.

Silver-steel was used for the anvil, reduced for $\frac{1}{2}$ in. at one end from $\frac{1}{4}$ in. to $\frac{3}{16}$ in. At $1\frac{3}{16}$ in. from the other end it is cross-drilled for the $\frac{1}{2}$ in. × $\frac{1}{8}$ in. diameter pin, which carries my main spring fork, and now we come to the sticky part. At $1\frac{13}{16}$ in. from the upper end, a $\frac{1}{16}$ in. hole is drilled for the pin which drives No. 1 wheel, but to accommodate the wheel I cut a clearing slot in the anvil, $\frac{5}{8}$ in. radius from the central arbor. This gives ample clearance to the wheel, which is $\frac{15}{16}$ in. P.C.D. No. 2 pinion is $\frac{5}{16}$ in., No. 3 wheel 1 in., and No. 4 pinion $\frac{1}{4}$ in., all pitch circle diameters.

At this point I must leave you to take dimensions from your wheels. As you will see from my section through the anvil, the actuating pin must ride in the space between two of the arms, free from the periphery, so the clearing slot must be both wide enough to accept the wheel and deep enough to ensure that the teeth do not contact at either end of the anvil's travel.

The indicator case must be drilled for the anvil at the centres determined by the wheels you have acquired. In all my sketches I use the pitch circle diameter to show the wheels, but a few teeth are indicated in the anvil section.

The order of assembly of these components is a little tricky. First fit the anvil with its main spring, but not the wheel actuating pin. Then fit the hairspring and rubber ring on the central arbor, plus No. 1 wheel, which must be perfectly free to rotate independently.

Slide the wheel alongside the hairspring, engage the wheel in the anvil slot, then enter the arbor into its bearing, which slides the wheel into its final position. Pin the hairspring and the anvil.

Pinion 2 and wheel 3 are both soldered to their arbor, and pinion 4 is also soldered on, but the pointer should be left for final positioning later.

The case cover is straightforward. It must be a sliding fit on the case, but the carrying of the dial in the cover offered a problem. This I overcame by inserting the glass, followed by three rings of thin cardboard (shown cross-hatched in my drawings), then the dial, the five layers being glued in position with shellac.

As my dial is merely a ring, I built up the cardboard until the distance from the back of the dial to the glass gave me a working clearance for the central arbor.

As a matter of fact, I overlooked this point, which came about through not making proper working drawings, and only just had enough room in the cover to take the grub screws which retain the cover and yet permit it to rotate. When marking out for these screws, ensure that the dial does not quite contact the case. If the boss of your pointer is thin you may prefer to use a complete dial, drilled to pass the arbor instead of a ring, but in mine I can "see the wheels go round."

Queries and Replies

No. 9884.—Bevel Gear for Right-Angled Drive
C.P. (Barnstaple)

Q.—I have to make several small gears for a right-angled drive. The ratio is not important, but the large gear has a maximum diameter of 0.215 in. and the small gear 0.160 in. and the centres are offset 0.015 in. I have tried using the standard bevel gear formula, and with 100 d.p. I had 16 and 20 teeth. These gears run together after being forced round, but I could feel the teeth clicking in. I have also tried making the teeth in a plain vee-form, which did help in running smoothly, but soon started to slip, as the teeth did not engage to the full depth. These gears are not subject to any load and it is essential that they run smoothly. The large gear is driven by the small gear which will revolve intermittently at approximately 100 r.p.m. The material I have used is brass. Are there any other formulae for gears that do not run on the same centre-line, and should I have a special form tooth?

R.—It is certainly possible to produce a form of bevel gear which will work efficiently with the shafts offset, and this type of gearing is sometimes used in motor car transmission, a well-known form being the Hypoid gear. We regret, however, that we are unable to give you any formula or instructions for the production of such a gear, but we suggest as an alternative, it might be possible to use two stages of gearing, the first being an ordinary bevel gear working with intersecting shaft axes, and use this in conjunction with an ordinary spur gear, which would enable the necessary offset to be obtained. This would take up a little more room, but would énable the gears to be used at their full efficiency. You do not state the amount of power that you wish to transmit by these gears, but brass gears are perfectly satisfactory if the duty required of them is not excessive. For higher powers, we should recommend a combination of brass and steel gears for the large and smaller gear wheels respectively.

No. 9878.—Contraction of Metals
J.L. (Wigan)

Q.—Could you tell me what rule (how much contraction per in.) should be used to make a pattern for an iron casting? What rule should be used to make a master pattern for an iron casting? Also the contractions for a pattern and master pattern for brass castings.

R.—The construction generally allowed for iron castings is $\frac{1}{8}$ in. to the foot. Pattern makers generally use a special rule, which can be obtained from tool dealers, giving a direct scale reading, which allows for the contraction of castings in various metals. With regard to the contraction of a master pattern, this depends entirely on what material is going to be used for the secondary pattern, produced for use in the foundry. In present-day practice, it is usual to employ a zinc base material, which has practically no contraction on cooling, and, therefore, the master pattern may be made with exactly the same contraction as if it were to be used directly for the production of the ultimate castings. The contraction of brass castings is approximately twice that of iron castings, namely $\frac{1}{4}$ in. to the foot.

No. 9890.—Electric Welder
O. F. (Newport)

Q.—I am thinking of making an electric welder. My generator is shunt wound, continuously rated, 29 V, 200 A, at 2,500 r.p.m. I would be pleased if you could help me by giving me information on making the resistance coils.

R.—29 V is unsuitable for any form of welding. A voltage of between 80 and 100 is necessary. Also, a welding generator is a special machine. An ordinary shunt dynamo is unsuitable. A welding generator must have what is known as a drooping characteristic, that is, the voltage must drop as the arc load is taken up. In your case it is not possible to increase the voltage, unless you can increase the speed of your generator by about two and a half times its present rate, and this, of course, is impracticable.

No. 9879.—Camera Focussing Movement
J.A.S. (Earls Court)

Q.—I should be very grateful if you would advise me as to how the focussing mechanism of a camera lens is normally designed?

R.—The great majority of modern cine-cameras are provided with a focussing movement on the helical principle, using either a helical slot or a coarse-pitch screw thread. The precise pitch in either case will depend on the extent of movement required, but it is not usually necessary to arrange for more than about ¼ in. of movement, which, allowing for a complete turn of the lens mount, would, of course, be equivalent to a pitch of ¼ in. In some cases multi-start threads are used on the lens mount, and in cases where it is not desirable for the lens mount to turn bodily, the mount is provided with an extra sliding jacket which is keyed to prevent rotation, though capable of being moved forward or backward by collars on the helical focussing member.

No. 9888.—Passenger-Carrying Electric Locomotive
R.G.W. (Rye)

Q.—I have been considering building an electric locomotive for hauling children at fetes, etc., and have been searching for a suitable type of motor to use for the job. As my knowledge of electricity is limited, will you please be kind enough to answer the following question:

Would a 12-V starter motor from a car, suitably geared down and mounted in a 5 in. or 6 in. chassis, be powerful enough to haul a driver and three child passengers?

If a petrol-driven generator is used generating 12 V, 300 W, is a storage battery necessary, or could the locomotive pick up the current straight from the generator *via* the rails, of course, and would there be a voltage drop due to the resistance of the rail (100 ft. long)?

If a car starter motor wouldn't do, is there any 12-V motor that would be suitable—ex-government surplus—or a standard commercial job?

Do you know of anyone who has experimented along these lines and what results they have had?

To do the above job, what, in your opinion, should the output from the generator be, and what should the voltage or amperage of the motor be; also, the capacity of the battery if required?

R.—A car starting motor would be very suitable for the purpose of driving a model railway system, though the motor will be much larger than is necessary for this purpose. A starter motor is designed to give a high horse power for a short period of time and may develop as much as 3 h.p. A ⅛ to ¼ h.p. motor would be better. A suitable motor taking a current of up to say 12 A on load can be used, and it is possible to find something in this line on the surplus market. So far as the power unit is concerned, a battery is not necessarily required. If the generator is suitably compounded it will be suitable for the sudden current demand at starting the motor. A plain shunt machine may not be suitable, as there is likely to be a very large voltage drop when a sudden heavy load is called for. If your generator is a shunt machine, the better plan would be to use a battery of half the normal output capacity and run the battery and generator in parallel when working the train.

Depending upon the bonding of the rail system, the resistance of the track may be good or bad; if good, the voltage drop will be reasonable. In real practice it is usual to feed the track at intervals along its length. You could do this by providing feeder cables at, say, three equal points along the track. If the rail bonding is perfect, it will only be necessary to feed the collector rail at these points. We cannot recall reading anything in connection with this matter as far as results are concerned, but if you proceed on the lines indicated, the results will be successful. A generator of approximately 300 W output would be ample, and a standard car battery would be suitable to use with it if this is considered necessary.

No. 9876.—Priming in Locomotive Boilers
G.C. (Stow-in-the-Wold)

Q.—I have just completed a boiler and chassis to Mr. R. A. Briggs's design for a Sentinel-type steam wagon published in your issue of 23rd December, 1943. To my disappointment, however, the boiler primes badly. The only differences I have made are that I have used copper instead of steel and have not fitted a superheater. Steam is taken from a small turret in the smokebox through one coil of tube (i.e. once round the smokebox) to the starting valve (screw-down type supplied by Stuart Turner Ltd.) which is alongside the boiler in the cab adjoining the driver's seat. From this valve steam goes to the cylinder valve-chest on the engine which is a Stuart that I had by me. A curious point is that no water is thrown out by the safety valve when it blows off, nor apparently does much, if any, come through the blower. It pours into the cylinder, however, when the regulator valve is opened. I have cleaned out the boiler several times. I would be greatly obliged for any suggestions you can make to cure the trouble.

R.—The trouble you are experiencing with

your boiler, however, is not abnormal, especially with a copper boiler, though it may possibly be aggravated for some time by the omission of the superheater. Perhaps the best remedy and the one which would most quickly eliminate the priming trouble would be to fit the super-heater; but we would suggest that you make use of the boiler as frequently as possible, and work it with not more than "half a glass" of water. It is generally accepted that a new copper boiler requires steaming some fifteen or twenty times before the tendency to priming disappears. In your case, there is nothing in the design which would normally lead to priming.

PRACTICAL LETTERS

Tempering Tools

DEAR SIR,—I found Mr. F. W. Rason's article very interesting, but I have always found the method described by him and "Novices' Corner" (Nov. 30th) for obtaining a "tapered temper" not very satisfactory. The holding device always tends to take heat away from the workpiece at the gripping point and leaves it harder than is required. The best method that I know of obtaining the effect is to put a sand bath over the gas and plunge the workpiece into the sand by the end required softest. The colour run can be seen without the glare of the light source giving a false impression.

I discovered a method of obtaining a uniform temper when I was doing my basic workshop training for the R.A.O.C. during the war. I was making a spring for a pair of calipers and I used a lead bath to temper it in. I obtained a uniform blue colour except where the pliers gripped it. On the second attempt I cleaned up the pliers and heated them up to a straw colour before letting down the hardness of the spring.

Yours faithfully,

East Ham. A. E. CLAWSON.

Aluminium in Refrigerator Compressors

DEAR SIR,—In reply to Mr. Charles H. Connells query dated 23/11/50. After running my refrigeration with its aluminium compressor and "Arcton 6" gas (British equivalent of "Freon 12") for some months of arduous work, testing, etc., after stripping compressor, I have found it still in its original perfectly clean and bright condition, which has further convinced me that as stated in "Refrigeration" by Moyer and Fittz—*F12 approaches nearly to the ideal refrigerant.* Further tests of U.S. Bureau of Mines. On *Aluminium*, cast-iron, babbit metal (67 per cent. lead), monel metal high and low carbon steels. All of which did not corrode in the presence of F12 dry at 235 deg. F. for a period of 5 months. A few metals like copper, bronze and lead were slightly darkened, but not corroded. Further test: F12 *Saturated* with water at *room temperature, then* 4 *months at* 235 *deg. F.* corroded only *Wymetal* and *magnesium alloy*.

The addition of white mineral oils to F12 has no effect on corrosion. In view of these tests by such a body as U.S. Bureau of Mines this information, should dispel all doubts of THE MODEL ENGINEER readers as to desirability of aluminium in conjunction with F12.

Yours faithfully,

Stroud. D. BROTHERS.

Truing up the Headstock

DEAR SIR,—There is what I consider a simpler and speedier method of aligning head and tailstocks of a lathe than that given to querist R.P., of Porthcawl. The procedure you advise does not introduce the tailstock at any point, yet he mentions his inability to turn parallel *between* centres.

My method is to mount the dial gauge on a holder gripped in the chuck (S.C. or independent, it matters not) and with the face of the dial "looking" toward the tailstock, plunger pointing to lathe centre-line. Advance the tailstock barrel so that it projects an inch or so, and adjust dial gauge so that plunger point bears on the barrel.

If the headstock mandrel is now slowly rotated, R.P. will note that the plunger is following an elliptical path due to the misalignment of his centres, and the headstock can be gently tapped over with a block of wood until the reading on the gauge shows no appreciable variation at any position round the barrel.

Your querist is almost certain to find, however, that tightening the headstock clamping-nuts or bolts will draw the headstock over slightly so that inspection of the gauge at different points around the barrel should continue to be made until all nuts are finally tightened. The headstock is now (a) parallel with the bed and (b) in line with tailstock centre.

Yours faithfully,

Croydon. L. A. WATSON.

An Old Locomotive

DEAR SIR,—I have an old book, *The Model Steam Engine* by "The Steady Stoker," published by Houlston & Sons in 1875, in which a precisely similar locomotive to Mr. A. J. C. R. Goodall's is illustrated. The screws for the side frames are shown more or less in the same place and the little triangular aperture filed out of the cylinder pivot support. The "Steady Stoker's" engine has the steam dome further forward on the boiler and it is fitted with a safety-valve, loaded by a spring balance behind. Mr. G. Gentry picked up a similar engine in a second-hand shop and described fully its construction in a series of articles commencing in THE MODEL ENGINEER on February 7th, 1929. Mr. Gentry's engine was $\frac{1}{4}$ in. bore $\times$ $1\frac{3}{8}$ in. stroke. It looks, therefore, as if this engine was a regular stock design.

Bateman, of Holborn, used to sell sets of castings for oscillating cylinder locomotives, but the only illustrations I have of these were for small outside cylinder locomotives.

Yours faithfully,

Swanage. H. E. RENDELL.